REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND THE LATE

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AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

ZOOLOGY—VOL. XXIII.

PART LXX.—REPORT ON THE HYDROIDA—SECOND PART

BY PROFESSOR G. J. ALLMAN

Published by Order of Her Majesty's Government

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE

AND SOLD BY

LONDON :—EYRE & SPOTTISWOODE, EAST HARDING STREET, FETTER LANE

EDINBURGH :—ADAM & CHARLES BLACK

DUBLIN :—HODGES, FIGGIS, & CO.

1888

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EDITORIAL NOTE.

THE First Part of the Report on the HYDROIDA, by Professor G. J. Allman, F.R.S., collected during the Expedition was published in 1883 in Volume VII., forming Part XX. of the Zoological Series of Reports; it treated of the PLUMULARIDÆ (Plumularinæ).

The present Memoir is the Second and concluding Part of Professor Allman's Report, and treats of the remaining families of the order.

In consequence of the extent and representative character of the collections Professor Allman has been able to give, in addition to the zoological descriptions, a very valuable and comprehensive sketch of the morphology and life-history of these animals. This Part consists of 160 pages of letter-press, 39 plates and a map. The Manuscript was received in instalments between the 29th August 1887 and 9th February 1888.

JOHN MURRAY.

CHALLENGER OFFICE, 32 QUEEN STREET,
EDINBURGH, *9th May* 1888.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the HYDROIDA dredged by H.M.S. Challenger during the Years 1873–76. By Professor G. J. ALLMAN, M.D., LL.D., F.R.C.S.I., F.R.SS. L. & E., M.R.I.A., C.M.Z.S., Mem. Roy. Danish Acad. Sci., &c.

PART II.—THE TUBULARINÆ, CORYMORPHINÆ, CAMPANULARINÆ, SERTULARINÆ, AND THALAMOPHORA.

PREFACE.

THE collection of Hydroida brought home by the Challenger contains representatives of almost every important group of this order. The Plumularinæ, to which I have devoted a separate examination in that part of the Report which has been already published, are richly represented in the collection, and examples of almost all the leading types of this beautiful group have been found in it. Many of these have afforded the means of working out certain morphological relations which throw light on the architecture of the group and demonstrate a fundamental unity amongst very diverse modifications of structure. The Hydrocorallinæ have been made the subject of a very valuable independent Report by Professor Moseley,[1] and it is now proposed to consider all the remaining Hydroid groups, examples of which were obtained during the Expedition. In addition to the new species certain previously known ones have been figured, when this seemed desirable.

I have taken advantage of the opportunity afforded by the typical character of the collection to make this the basis of a general exposition of Hydroid morphology, from the

[1] Report on certain Hydroid, Alcyonarian, and Madreporarian Corals, Zool. Chall. Exp., part vii.

standpoint of our present knowledge, in the hope that a higher morphological interest might be added to a work which would otherwise have contained little more than descriptive and distributional details.

Two or three species have by an oversight received names which had been already appropriated. In the Explanation of the Plates, however, and in the Index, legitimate names have been substituted for those previously used, while the latter have been retained between brackets, and it is hoped that all danger of confusion will be thus avoided. The magnified figures contained in the Plates have been all drawn by the author, and in almost every instance those which represent the natural size of the species by Miss M. M'Daniel.

To Mr. John Murray, the Director of the Literary Staff of the Expedition, my best thanks are due for the readiness with which he acceded to everything which might facilitate my work, for the courtesy which I received from him throughout, and for the patience with which he met the somewhat tardy appearance of the Report. To Mr. William E. Hoyle I am also much indebted for valuable assistance in the verification of localities, and in the general supervision of the proofs.

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GENERAL INTRODUCTION.

Among the Hydroids to which the present part of the Report is devoted, the Gymnoblastic genera are but sparingly represented, while, on the other hand, a rich and highly interesting collection of Calyptoblastic forms has been obtained. These are for the most part well preserved—so well, indeed, that in many instances the hydranths and other soft parts of the colony have retained their characters in so good a condition as to allow of these parts being drawn with most of the natural features of the living animal.[1]

It is however somewhat disappointing to find that a large proportion of species is represented by the trophosome alone, a fact probably due to the circumstance that many of these species were obtained at seasons when no gonosome is developed by them. Notwithstanding, however, the absence of this important element of the colony, it was seldom that any difficulty was experienced in assigning a specimen to its true place in the system.

No planoblasts or free-swimming sexual buds of Hydroid colonies are contained in the collection placed in my hands. A few deep-sea Craspedote Medusæ, some of which are probably the planoblasts of unknown Hydroid trophosomes, have formed part of a separate Report by Professor Haeckel.[2]

The rare occurrence in the collection of such species as are known to inhabit the European Seas is striking, and points to a definiteness in the geographical distribution of the Hydroida which could scarcely have been expected, and which certainly contrasts with the wide distribution met with among many species of Polyzoa.

Among the new forms described in the present part of the Report are several which render necessary the definition not only of new generic groups, but of new families. Among the groups most richly represented in the collection, and of which compara-

[1] Were it not that the Plumularinæ have been dealt with in the former part of this Report (Zool. Chall. Exp., part xx.), they would form the final group in the arrangement of the Hydroida here followed. The group here indicated under the name of Plumularinæ is exactly co-extensive with the Plumularidæ of the former part. The subordination of groups here employed is I believe in accordance with the requirements of Hydroid classification, but had been decided on too late to allow of its adoption in the part of the Report already published.

[2] Report on the Deep-Sea Medusæ, Zool. Chall. Exp , part vii.

tively few examples had hitherto been known, are those to which belong the genera *Cryptolaria* and *Grammaria*, as well as a new and very interesting genus to which I have assigned the name of *Perisiphonia*, and of which the collection contains two species.

An examination of the specimens by which these genera are represented has shown that they possess a remarkable and hitherto unsuspected type of structure, rendering necessary the institution for them of two new families, while to one of these families must also be referred certain other genera with which zoologists have long been familiar, but in which the essential character of the family had been overlooked.

Idia, hitherto known only by the very deficient description and figure of Lamouroux,[1] and of which only a single species, *Idia pristis*, has as yet been discovered, is represented by examples which show that it is constructed on a type quite unique among the Hydroida, and one which demands the allocation of it to a special Hydroid section. To this section I have assigned the name of Thalamophora.

Among other families largely represented is that of the Haleciidæ, with not only many new species, but with one form which must be referred to a new generic type, and which is rendered especially interesting by the fact that the colony is provided with bodies which admit of a close comparison with the sarcostyles and sarcothecæ of the Plumularinæ. Similar bodies are also borne by the two species of *Perisiphonia* already referred to, and by a species referable to the new genus *Hypopyxis*. The presence of these bodies, formerly supposed to be confined to the Plumularinæ, with a very few forms belonging to other groups, has thus been shown to be by no means so limited as had been imagined.

In two species, one of which is referable to *Sertularia* and one to *Thuiaria*, the specimens afford abundant evidence of the fact that the hydranths are incapable of complete retraction within the hydrothecæ. In both of these the body of the hydranth is connected with the wall of the hydrotheca by ectodermal bands quite similar to those which in most Hydroid trophosomes connect the cœnosarc with the walls of the perisarcal tube, or the blastostyle with those of the gonangium. In at least one of these the tentacles of the hydranth are each provided at its base with a prominent cushion loaded with thread-cells, and forming a defensive battery in which we can scarcely avoid seeing a provision, the object of which is to act as a compensation for the comparatively unprotected condition of the hydranth.

The curious genus *Synthecium*, in which the gonangia spring from within the cavity of the hydrotheca, is represented by two new species, both from the Australian seas, thus extending our knowledge of the range of this genus, which had been previously known only through specimens obtained from the region of New Zealand. There also occur fine

[1] Mr. Hincks has since sent me a specimen of this Hydroid from the Mergui Archipelago, while I am also indebted to my late lamented friend Mr. Busk for an opportunity of examining singularly fine specimens from the Persian Gulf.

examples of the remarkable genus *Thecocladium*, in which every branch of the colony springs like the gonangium in *Synthecium* from within the cavity of a hydrotheca.

The few Gymnoblastic or Tubularian Hydroids in the collection belong to three genera, *Stylactis*, *Eudendrium*, and *Monocaulus;* the species by which the last is represented being perhaps the most remarkable Hydroid obtained during the Expedition. When we keep in mind that its stem measures half an inch in thickness by seven feet in height, and that its hydranth extends nine inches from tip to tip of its tentacles, we must admit that as regards size every other Hydroid sinks into insignificance when compared with it; while the depth of about four statute miles from which it was brought up adds to the special interest of this marvellous animal. It will further be seen that so far as the specimens admitted of anatomical study certain points of structure which scarcely yield in importance to the other characters have been demonstrated in it. Fortunately a drawing of it was made by Mr. J. J. Wild immediately after its capture, otherwise it would have been impossible to have given a correct delineation of its natural aspect.

The extent of the collection and its representative character render it eminently fitted for the illustration of general Hydroid morphology; for with the exception of the Hydrocorallinæ, which have already formed the subject of a separate Report by Professor Moseley, it contains examples of almost all the leading types of Hydroid form. I believe, therefore, that it will add to the value of the Report, and help to convey a definite conception of the terminology, if, before entering on the purely descriptive zoology of the species, a sketch be given of the morphology and classification of the Hydroida, aided by such illustrations as may be afforded by the various forms included in the Report.

SKETCH OF THE MORPHOLOGY AND LIFE HISTORY OF THE HYDROIDA.

I. Fundamental Form. General Architecture of the Hydroida.

The fundamental form to which every Hydroid may more or less directly be referred is that of a cylindrical tube closed at one end, and terminating at the opposite end in a conical prolongation, which carries on its apex an orifice through which the cavity of the tube communicates with the exterior. Projecting in a circle which surrounds the base of the cone are certain hollow cylindrical offsets, each of which has its axis occupied by an extension of the central cavity. This cavity is the digestive cavity of the Hydroid, the terminal orifice which opens into it is the mouth, and the cylindrical offsets which encircle the terminal cone or hypostome constitute a system of tentacles which form an apparatus of prehension and defence.

Retaining this fundamental type-form we have the fresh-water *Hydra*, but almost

the whole of the remaining representatives of the order present it in a more or less modified condition, while they have in almost every instance become variously complicated by the formation of hollow buds, whose cavity is continuous with that of the primary Hydroid, with which most of them remain in permanent union. Many of these buds become elongated into branches, and thus give rise to complicated colonies, which often present luxuriant tree-like growths, and repeat with wonderful fidelity the most elaborate ramification of the vegetable kingdom (Pls. II., IV., IX., &c.).

Even in *Hydra*, however, this complication by budding, and the consequent formation of dendritic colonies, is foreshadowed by the emission of buds, but here the buds, after attaining maturity, detach themselves, and leave the parent simple as before.

It will be hereafter shown (page xxviii) that even the generative buds which have become detached under the form of Medusæ or "jelly-fish," in order to spend henceforth a free life in the open sea, may be referred to the same fundamental type of form. It must accordingly be borne in mind that not only the polyp-form as shown in *Hydra*, but the Medusa-form as shown in the Craspedotæ or Hydro-Medusæ (see below, page xxv, note), must be included under the common order, Hydroida.

II. Disposition of the Fundamental Layers.

The parts which enter into the composition of the Hydroid body are disposed in two fundamental cellular layers, separated from one another by a thin, structureless, excreted membrane, while the whole is for a greater or less extent, in the great majority of cases, surrounded by another structureless membrane, also the product of excretion.

Of the two cellular layers the more internal one lines the body-cavity and its offsets, and forms the *endoderm;* the more external, which is exactly coextensive with this, is the *ectoderm*, while the thin, structureless membrane which everywhere intervenes between endoderm and ectoderm is the *mesosarc*,[1] and the structureless coat which in almost every case surrounds and protects the soft parts in the stems and branches is the *perisarc.*

A Hydroid colony, then, such as we meet with in the great majority of instances, presents a ramified growth whose stems and branches are elongated, intercommunicating tubes, the common cavity of which forms the nutritive cavity of the colony, and whose walls are composed of endoderm and ectoderm, separated from one another by the mesosarc, and protected externally by the investing perisarc. The living nutritive tube which lies within the perisarc and is the common basis from which all the buds are emitted is known as the *cœnosarc.*

[1] This is the "Stützlamelle" of Reichert, who was the first to call attention to it. It must not be confounded with the "mesoderm" or middle germinal layer of the embryo, a layer which does not occur in the embryonal development of the Hydroida.

III. Diversity of Form and Function in the Buds.

But it is not simply in the form of elongated branches that the buds become developed. At the extremities of the stem and branches, or on offsets which bud forth from definite points on their sides, the cœnosarc frees itself from its close perisarcal coat and undergoes a remarkable and characteristic development, being here transformed into a more or less club-shaped body, which throws out tentacles from its sides and becomes perforated by a terminal mouth. This remarkable body, which thus repeats in all essential features the structure and form of a solitary or primordial Hydroid, is known as the *hydranth* (Pl. II. fig. 2; Pl. VII. fig. 2; Pl. XII. fig. 1*a*). Within its cavity, which communicates with that of the general cavity of the colony, the most active digestive processes are carried on. It is the element on which the nutrition of the Hydroid specially devolves, and that which gives to the living colony its most characteristic physiognomy, its circlet of tentacles, radiating round a central point, conferring on it that singular resemblance to an expanded flower which had from a remote period arrested the attention of every observer of these animals in their living state.[1]

But, besides these flower-like nutritive buds, there are others which make their appearance at certain seasons, and whose function is not that of procuring and elaborating nutriment for the colony. These are also budded forth from various parts of the colony, and are either in the form of fixed sac-like bodies (Pl. I. figs. 1, 2; Pl. III. fig. 3; Pl. VII. fig. 4, *b*, &c.), in which a suppressed medusoid conformation may in many instances be detected, or in that of completely developed Craspedote Medusæ, which after a time become detached from the colony, and lead henceforth an independent life. The function of these, whether they be fixed sacs or free-swimming Medusæ, is that of protecting the generative elements—ova or spermatozoa—and in some cases giving origin to them. They are known as *gonophores*.

It will be thus seen that a typical Hydroid colony consists of an assemblage of buds, each endowed—whether permanently attached to the colony or free—with a more or less independent life. To these buds different functions have been assigned, and the whole are associated into a community by a common living basis—the cœnosarc. Their independent life entitles them to be distinguished from mere organs, and they may be appropriately designated "zooids," as originally proposed by Huxley. They are the "personæ" in the terminology of Haeckel.

[1] Weismann (Die Entstehung der Sexualzellen bei den Hydromedusen) does not confine his conception of the hydranth to this club-shaped body with its mouth and tentacles, and proper stomach cavity, but extends it in the case of the tree-like Tubularian and Campanularian Hydroids to the whole of that portion of the stem which lies between the hydranth as here limited and the first lateral branch. To this portion of the stem he gives the name of hydranth-stalk (Hydranthenstiel), while he designates the proper hydranth as the hydranth-head (Hydranthenkopf), and he justifies this recognition of the stalk as an integral part of the hydranth by the conclusion to which he has been led, that on it, and *only* on it, in dendritically branched colonies is the "budding zone" or place where a new hydranth bud may be formed.

Now, the whole of the *nutritive* zooids or hydranths with the connecting cœnosarc may be regarded as forming a distinct system, while the *generative* zooids or gonophores, along with such parts as they may be provided with for protection or otherwise, will form another. The former will constitute the *trophosome* of the colony, the latter the *gonosome*.

The zooids, which have just been referred to the trophosome and gonosome, have been found in all Hydroids which have been adequately studied, with the exception of some free Medusæ in which no independent trophosome is present (see below, p. xxviii), of *Hydra* in which the protection of the generative elements is not assigned to distinctly differentiated zooids, and of the somewhat enigmatical *Protohydra* of Greeff, which according to that author is a Hydroid presenting a condition of extreme simplification, being destitute of tentacles and multiplying only by division of its body.[1] In some, however, there occurs an additional set of zooids, whose functions, though scarcely yet ascertained with certainty, would seem to be in some cases chiefly that of the defence of the colony, as may be assumed of the "spiral zooids" of *Hydractinia*, and the "dactylozooids" of the Hydrocorallia; and in other cases that of the prehension of nutriment, as is probably the case with the nematophores or *sarcostyles* of the Plumularinæ and of a few other groups.

It will thus be apparent that the zooids of the Hydroid colony, with their various forms and definite functions, are the expression of a physiological division of labour, while as we advance towards higher groups of the animal kingdom we find the various kinds of physiological work assigned, not to different *zooids*, but to different *organs* which have lost the independence which more or less characterises the zooid.

IV. Histology of the Fundamental Layers.

What has now been said will serve to indicate the salient points of the morphology of the Hydroida. For an adequate conception, however, of Hydroid organisation, a more intimate knowledge of structure will be necessary, and this will be best acquired by a detailed examination of each of the fundamental tissue layers.

1. *The Endoderm.*

The endoderm consists generally of a single layer of prismatic cells, whose bases rest externally on the mesosarc, and whose opposite ends bound the common cavity of the colony. Those ends of the endodermal cells, which thus lie free in the nutritive cavity, are each provided with a simple flagelliform cilium, by whose vibrations the contents of the cavity are kept in constant motion.

In *Myriothela* the endoderm of the whole of the main cavity of the body forms a thick layer composed of many cells in depth. The cells, which in *Myriothela* form the

[1] R. Greeff, *Zeitschr. f. wiss. Zool.*, Bd. xx., 1869.

greater part of the thickness of this endodermal layer, consist of round nucleated masses of clear protoplasm, while those which lie directly on the walls of the cavity are ciliated, and overlaid by a thin layer of free protoplasm, through which the cilia pass, and which has the faculty of emitting pseudopodia.

In *Tubularia indivisa* also, and in *Corymorpha*, the endoderm of the stem is composed of many layers of round cells. These would form a solid mass, filling the cavity of the stem in these Hydroids, were it not that the endoderm is here traversed by numerous longitudinal canals, which run parallel with the axis, anastomosing with one another here and there, and opening above into the gastral cavity of the hydranth. These canals represent the simple cavity which extends through the axis of the stem in other Hydroids, for there is here no axial cavity in the stem, its place being taken by a large and clear-celled modification of the more peripheral portion of the endoderm.

In *Monocaulus imperator* the endoderm of the stem is traversed as in *Tubularia indivisa* and in *Corymorpha* by longitudinal anastomosing canals (Pl. III. figs. 1, 4); but here a wide, continuous cavity runs through the whole length of the axis.

The nutritive cavity of the Hydroida is generally dilated in the body of the hydranth, so as to form the proper stomach, and then the body of the hydranth with its included cavity contracts towards the mouth into a conical, or in some cases, a trumpet-shaped, proboscis or *hypostome*.

In many species of *Tubularia* and other Hydroids which form the section Gymnoblastea, the endoderm of the hypostome is thrown into longitudinal ridges, mostly four or five, which project into its cavity, and then passing downwards become in the stomach broken up into several branches, which soon lose themselves on the general endodermal lining.

These endodermal ridges, which are also well developed in the nearly allied order of the Siphonophora, were first pointed out by von Koch,[1] and have been since noticed by many observers, but more especially by Hamann,[2] who adopted for them Haeckel's term "tæniola," a term, however, which Haeckel uses in a different sense, applying it to the prominent gastral ridges which are characteristic of the Scyphistoma or polyp form of the Acraspedal Medusæ.[3] Hamann attributes to the endodermal ridges of the Hydroida a high systematic value, and regards their presence as the true grounds on which the Gymnoblastic Hydroids admit of being separated as a natural group from the Calyptoblastic forms.

This, however, is assigning to them an importance greater than they can fairly claim. They are by no means absolutely constant either in their form or their presence in the Tubularians. In *Tubularia indivisa* they are represented by pendulous pyriform lobes

[1] G. v. Koch, Vorläufige Mittheilungen über Cölenteraten, *Jenaische Zeitschr.*, Bd. vii. p. 512, 1873.
[2] O. Hamann, Der Organismus der Hydroidenpolypen, *Jenaische Zeitschr.*, Bd. xv.
[3] Ernst Haeckel, Das System der Medusen, Jena, 1879.

of the gastric cavity of the hydranth, while in *Myriothela* they are replaced by long, nipple-like processes of the endoderm, which project into the gastric cavity throughout its whole extent, except for a short space immediately below the mouth. These processes, like the more external portion of the endoderm, are formed of large, round, nucleated cells, but at their free extremities they are surrounded by numerous smaller cells which are loaded with coloured granules and are probably to be regarded as gland-cells. In the hydranths, indeed, of almost all Hydroids, certain endodermal as well as ectodermal cells would seem to possess the function of gland-cells. These endodermal gland-cells are chiefly developed in the walls of the hypostome.

In almost all Hydroida the endoderm undergoes a remarkable modification in the interior of the tentacles. In *Hydra* and *Myriothela* the tentacles have a hollow tubular axis, which communicates freely with the gastric cavity, and whose endodermal lining is a simple continuation, in a scarcely altered condition, of that of the body cavity.

In *Garveia nutans* also, the tentacle presents a continuous tubular axis, but the endoderm consists here of a regular series of large, clear, flat cells, piled on one another from the base to the apex of the tentacle, having their outer sides turned towards the ectoderm, from which they are separated only by the mesosarc, while their inner sides so encroach on the axial tube as nearly to obliterate it. In every other instance hitherto examined the tentacles of the hydranth are destitute of a cavity and their axis is occupied by a solid core of endoderm. In the great majority of cases this endodermal core is composed of a very remarkable tissue, which consists of large, cylindrical, or disc-shaped cells, which are arranged one over the other in a continuous series like coins in a rouleau. These cells have a distinct membrane and clear contents, with a central nucleus which is embedded in protoplasm, and frequently suspended by protoplasmic filaments to the walls. Kölliker assigns to this structure a place among the connective tissues, and Haeckel, under the name of "chordal tissue," compares it, as it occurs in the tentacles of certain Medusæ, to the tissue of the vertebrate notochord, to which it bears a strong resemblance.

In *Tubularia* and in *Corymorpha* the tentacles are disposed in two circlets, and the axial cells of the tentacles belonging to the proximal circlet become longitudinally divided, so that the axis presents the form of a tissue in which the cells have become multiplied laterally, and which is consequently no longer in the form of regularly superimposed discs. The tentacles of the distal circlet, however, in both these genera possess the ordinary rouleau-like axis.

It would seem that the solid axial tissue of the tentacles is in every instance separated by the mesosarc, not only from the ectodermal layer of the tentacle, but by a duplicature of the mesosarc from the endoderm which lines the body-cavity of the hydranth, as was first pointed out by von Koch[1] in *Tubularia*, where the axial

[1] G. v. Koch, *loc. cit.*

tissue acquires increased development at the base of the tentacles, and thus forms a circular ridge which, pushing before it the mesosarc and gastral endoderm, projects into the gastral cavity of the hydranth.

Though the axial tissue of the tentacles is thus separated by a layer of mesosarc from the endoderm which lines the gastral cavity, there is no reason why it should not be regarded as a special modification of the general endoderm of the body, and to speak of it, as Jickeli does, under the name of "mesoderm," as a third body layer appears to me to convey an erroneous view of its fundamental nature.

This obliteration of the tentacular cavity, though almost universal in the hydranth, is far from being so in the marginal tentacles of the Medusa. Here, though in many cases (Trachomedusæ and Narcomedusæ, Haeckel) the endoderm presents the rouleau-like condition, with obliteration of the lumen, in many others (Anthomedusæ and Leptomedusæ, Haeckel) the axis continues pervious, and the endoderm forms a simple lining of the cavity with usually more homogeneous cell contents, but otherwise differing but little from that found in other parts of the body walls.

Though the existence of muscular filaments in the ectoderm of the Hydroida has long been known, it is comparatively lately that evidence has been adduced of their presence in connection with the endoderm. Weismann was the first to point out the existence of these endodermal fibrillæ which he found to occur in *Eudendrium*;[1] while the same have been found by Hamann[2] and by Jickeli[3] in other Hydroids. The fibrillæ of which this musculature consists always run in a circular or transverse direction, thus contrasting with the fibrillæ of the ectoderm which, at least in the trophosome, are always longitudinal. It is in the hypostome that they are most strongly developed, and here only do they occur, according to Hamann, in the Calyptoblastea, while in the Gymnoblastic genera they are found also in the walls of the gastric portion of the hydranth. They have not been detected in the cœnosarc. They would seem to be formed as outrunners from certain cells of the endoderm in a way similar to the formation of the longitudinal muscular fibrillæ in the ectoderm, where, as we shall presently see, the fibrillæ form outrunners from the most superficial cells of this layer.

2. *The Ectoderm.*

The ectoderm, like the endoderm, with which it is exactly co-extensive, and from which it is separated by the mesosarc, is also composed of nucleated cells. These cells are sometimes disposed in a single layer as in the ordinary condition of the endodermal cells, sometimes in several, while very frequently the cell-boundaries

[1] Weismann, Ueber eigenthümliche Organe, bei Eudendrium, *Mittheil. aus der Zool. Stat. zu Neapel*, Bd. iii.

[2] Hamann, *loc. cit.*

[3] Carl F. Jickeli, Der Bau der Hydroidpolypen, *Morphol. Jahrb.*, Bd. viii.

become obliterated, so that an obvious cellular structure becomes obscured, or entirely effaced.

The muscular fibrillæ of the ectoderm are in most cases well developed. Where they exist in the trophosome they always run longitudinally, and form a continuous fibrillated layer in contact with the external surface of the mesosarc. This ectodermal musculature is well developed in the body and tentacles of the hydranth. In those genera in which the body of the hydranth is much elongated so as to assume the form of a naked stem (*Hydractinia*, *Clava*, *Clavatella*, *Gemmelaria*, *Myriothela*), this part of the animal manifests a high degree of contractility, and the fibrillated tissue is here always especially well developed. In the cœnosarc of *Tubularia* in which this part is closely invested by the perisarc no fibrillæ can be detected, while in the allied genus *Corymorpha*, whose stem is not as in *Tubularia* enclosed in a thick perisarcal tube, the fibrillated tissue may be traced through the whole length of the stem. It is worthy of remark that though no fibrillæ can be detected in the cœnosarc of the adult *Tubularia* these are present on the whole body of the Actinula or larval stage of this genus. The fibrillated tissue, however, is not necessarily absent from such cœnosarcs as are enclosed in a firm perisarc. In *Plumularia echinulata* of Weismann this observer has detected and described the fibrillæ of the cœnosarc.

The tentacles of the hydranth in the various genera have an especially well developed system of ectodermal fibrillæ. In the tentacles of *Tubularia indivisa* the fibrillæ of the ectoderm may be seen to be true muscle-cells, being greatly elongated fusiform cells, each with a nucleolated nucleus.[1] A similar structure has been shown by Weismann[2] in the fibrillated tissue of the cœnosarc of *Plumularia*. In *Myriothela*, however, the fibrillæ would appear to be on a higher grade of development, for here they do not present the condition of nucleated fusiform cells. In this remarkable genus the fibrillæ have a uniform thickness throughout, showing no tendency to thin away into the terminal points of fusiform cells, and are without any visible nucleus.[3]

The ectodermal fibrillæ in the body of *Hydra* were examined by Kleinenberg[4] and shown by him to be in direct continuation with certain tail-like processes which are given off from the deep side of the most superficial cells of the ectoderm in this genus. Kleinenberg, believing that in this relation we have a low stage of development of a combined muscular and nervous system, designates the whole cell with its caudate process and fibrilliform continuation by the name of "neuro-muscle-cell." This capital discovery of the caudate processes of the ectoderm cells in *Hydra*, and their connection with the muscular fibrillæ, has been amply confirmed by subsequent observers and extended to many genera besides *Hydra*, so that it must now be accepted as representing

[1] Gymnoblastic Hydroids, p. 206, pl. xxiii. fig. 6.
[2] August Weismann, Die Entstehung der Sexualzellen bei den Hydromedusen, Jena, 1883.
[3] Allman, On the structure and development of Myriothela, *Phil. Trans.*, vol. clxv. part ii.
[4] Nicolaus Kleinenberg, Hydra, eine anatomisch-entwickelungsgeschichtliche Untersuchung, Leipzig, 1872.

the general structure of the ectoderm in the Hydroida. If, however, Jickeli be correct in assigning a nervous function to certain cells which he finds generally distributed in the ectoderm of the Hydroida, and which he regards as ganglion cells (see below, p. xvii), then the physiological significance which Kleinenberg attributes to his neuro-muscle-cells must be somewhat modified.

While in the Hydroid trophosome the muscular fibrillæ of the ectoderm are thus always longitudinal it is different with the Medusæ. Here a circular musculature is largely and characteristically developed in the ectoderm of the sub-umbrella or concave side of the walls of the bell-cavity, while the velum is itself mainly an offset of the ectoderm in which circularly directed fibrillæ constitute the chief part of its substance. While the muscular fibrillæ of the trophosome, whether in the ectoderm or in the endoderm, show no trace of striæ, the fibrillæ which run in a circular direction in the umbrella of the Medusa are transversely striated.

The ectoderm in most Hydroids is separated from the surrounding perisarcal tube by a wider or narrower space. Across this space, whether it be in the stems or in the gonangia, numerous narrow processes are sent off from the outer surface of the ectoderm to become attached by their ends to the inner surface of the perisarc. In these processes no distinct cell boundaries can be detected, and the same is very frequently the case in the ectoderm from which they proceed. In the living animal a most interesting protoplasmic movement may be seen in them, the processes constantly changing their form, frequently throwing out branches like the pseudopodia of certain Rhizopods, and extending and withdrawing themselves across the intervening space. When they reach the perisarc their ends flatten themselves out on it and emit radiating filaments of protoplasm. From these flattened ends the rest of the process frequently breaks away, leaving the extremity with radiating protoplasmic filaments attached to the walls where they have exactly the appearance of typical stellate cells (Pl. XXV. figs. 1*a*, 2*b*).

Among the Hydroids of the present Report are species (Pls. XXVII. fig. 1*a*; Pl. XXXIII. fig. 2*a*) in which similar ectoderm bands are seen stretching from the body of the hydranth to the walls of the hydrotheca, a condition which I have also observed in some British Sertularians. In the Challenger species in which those bands occur the hydranth would seem to be incapable of complete retraction.

Reichert[1] was the first to call attention to the emission of pseudopodia-like filaments by the ectoderm, and was led by it into the erroneous belief that the Hydroid cœnosarc consists of an undifferentiated protoplasm,—a view which, not obtaining the acceptance of any zoologist who had studied the structure of these animals, resulted in his very interesting and significant observation of protoplasmic movements in the cœnosarcal processes remaining long unrecognised.

Hamann[2] has shown that a similar emission of pseudopodial filaments takes place

[1] Carl B. Reichert, Über die contractile Substanz und ihre Bewegungs-Erscheinungen, Berlin, 1867.

[2] O. Hamann, *loc. cit.*

in the ectoderm of the foot-disc of *Hydra*. The remarkable development of pseudopodia by the sarcostyles will be described below when considering the structure of those bodies.

Thread-cells.—Of all the elements of the ectoderm the thread-cells or urticating capsules are the most characteristic. These bodies, however, are by no means confined to the Hydroida, but occur under various forms as a distinguishing and universally present feature in the whole of the Cœlenterata with the exception of the sponges—taking for granted that these have their true place in the Cœlenterate subkingdom.

The thread-cell varies both in form and in size in different species of Hydroida, and even in different parts of the same Hydroid, but it may be described as essentially consisting of a containing capsule and a contained filament which under certain conditions admits of being projected from the capsule.

The thread-cell however possesses a really complicated structure, the exact determination of which is exceedingly difficult, but from what has been satisfactorily established by the most careful observations, it may be regarded as certain that the thread-cell in its typical form, such as is seen in the larger thread-cells which occur in the body of *Hydra* or in the spherical capitula which terminate the tentacles of *Coryne*, consists essentially of an oviform rigid capsule lined by a fine membrane, which at one end of the long diameter of the capsule is invaginated into its cavity in the form of a tube occupying the axis, and there becoming continuous with a very fine and long tubular filament which lies in a congeries of coils within the capsule. The whole is included in an external cell, the *cnidocyst*, within which it has been developed, while the cnidocyst itself sends off from a point close to its summit or discharging pole a minute bristle-like process of its protoplasm, the *cnidocil*, which projects beyond the surface of the ectoderm into the surrounding water.

This is the condition of the typical thread-cell in its quiescent state, but under the influence of certain stimuli, not yet well understood, and which are probably exerted through the medium of the cnidocil, its characteristic action is brought into play, and a remarkable change takes place in it. The tube, which in the quiescent state lay in the axis of the capsule, is now suddenly projected through the discharging pole, and this act is immediately followed by a similar projection of the fine tubular filament with which at its free end the axile tube is continuous, and the capsule is thus emptied of its contents. The whole of this process consists in an act of evagination by which the wider axile tube and the fine tubular filament into which this is continued are transferred from the inside to the outside of the capsule.

When this sudden act of evagination has been completed it is seen that the portion of the tube which in the inverted state had lain in the axis of the capsule, is provided, in the form of thread-cell here taken as the type, with a verticil of barb-like spines attached to what has now become the outer surface of its walls. It continues to be attached by

one end to the summit of the capsule, and thence tapers away to a point where it is continued into the fine filament which is now seen to have uncoiled and extended itself, often to a great length, over the field of the microscope.

F. E. Schulze[1] called attention to the occurrence of a fine process which in *Syncoryne* proceeds from the base of the cnidocyst towards the deeper parts of the ectoderm. Somewhat later[2] I described in *Myriothela* a remarkable modification of the thread-cell, which among other peculiarities is distinguished by the presence of a peduncle in the form of a long slender filament which is attached to the base of the cnidocyst, and thence extends among the cells of the ectoderm towards the deeper parts of this layer. These peduncles are manifestly of the same nature as those described by F. E. Schulze in *Syncoryne*. They may be designated by the name of *cnidopods*.

Similar filaments have since been described by Grobben,[3] Ciamician,[4] and especially by Hamann,[5] who finds them in every Hydroid he has examined, and in all thread-cells, both large and small. He traces them through the thickness of the ectoderm as far as the mesosarc to which he believes them to be attached, and regards them as simply performing the part of mechanical supports of the thread-cells. He finds quite the same condition in the thread-cells of the tentacles of all craspedote Medusæ, and in the Siphonophora; also in *Actinia*, where these filaments had been already described by O. and R. Hertwig.[6]

The cnidopods have also been described by Jickeli,[7] who has subjected them to a careful study in several Hydroids. He regards them as muscular, describes in them a tendency to fibrillisation, and believes that he has seen them in various states of extension and contraction. This view of the muscular nature of the cnidopods receives support from an observation by Claus,[8] who in a Medusa, *Charybdœa marsupialis*, describes thread-cells from which muscular fibrillæ are sent off, and is further supported by an observation which we owe to Chun,[9] who has seen in the Siphonophora thread-cells which are clothed by a plexus of very fine muscular fibrillæ which become united below into a stalk. Notwithstanding those facts, however, it does not seem that evidence has yet been adduced which would justify us in accepting as proved the muscular nature of the cnidopods.

As already mentioned, Kleinenberg describes in *Hydra* cells which lie superficially in the ectoderm, and send off from their deep surface tail-like prolongations which become

[1] F. E. Schulze, Ueber den Bau von Syncoryne Sarsii, 1873.
[2] On the Structure and Development of Myriothela, *Phil. Trans.*, vol. clxv.
[3] C. Grobben, Über Podocoryne carnea, *Sitzungsb. d. k. Akad. d. Wiss. Wien*, 1875.
[4] J. Ciamician, Über den feineren Bau und die Entwicklung von Tubularia, *Zeitschr. f. wiss. Zool.*, Bd. xxxii.
[5] O. Hamann, *loc. cit.*
[6] O. und R. Hertwig, Die Actinien, 1879.
[7] Carl F. Jickeli, *loc. cit.*
[8] C. Claus, Untersuchungen über Charybdœa marsupialis, *Arb. Zool. Inst. Wien*, Bd. i.
[9] C. Chun, Die Natur und Wirkungsweise der Nesselzellen bei Cœlenteraten, *Zool. Anzeiger*, No. 99.

continuous with the longitudinal muscular fibrillæ. Lying between the caudal prolongations of these superficial cells, are other cells destitute of prolongations, and forming a tissue to which Kleinenberg gives the name of interstitial tissue.[1] It is among these interstitial cells of *Hydra*, and among cells which, by their deep position in the ectoderm and freedom from connection with the muscular fibrillæ, correspond to them in other genera, that we find the cnidocysts or cells within which the thread-cells are formed.

The thread-cells are developed out of the protoplasm of the cnidocysts in a way not yet determined, and without the direct participation of the nucleus of the cnidocyst, which after the development of the thread-cell still continues visible in it. Jickeli, from some observations which he has made on the thread-cells of *Hydra*, concludes that the axial tube is at first present as an external extension of the walls of the capsule, and that it subsequently becomes internal by invagination.[2]

Since the thread-cells in order that they may exert their proper function must be among the most superficial cells of the ectoderm, a migration from the deeper to the more superficial parts of this tissue-layer becomes necessary. It will be afterwards shown that the faculty possessed by certain cells, both of the ectoderm and endoderm, of wandering from one part of the Hydroid body to another, is now a well-established fact. No light has yet been thrown on the mode of formation of the cnidopods or filiform processes which are sent off from the bases of the cnidocysts.

That the thread-cells serve as weapons of defence and offence is now generally admitted. Their whole structure, and the phenomena which they present when called into action, are all in favour of the view which would assign to them such an office in the economy of the animal. Their benumbing and even fatal action on the animals with whose surface they come in contact has been too often noticed to allow of any doubt on this point. Semper[3] has described a gigantic Plumularian, a native of the East Indian Archipelago, which attains nearly the height of a man, and which on account of its formidable stinging properties is held in dread by bathers. Kirchenpauer has identified Semper's Plumularian with an *Aglaophenia* to which he assigns the specific name of *philippina*, probably identical with *Aglaophenia macgillivrayi*, examples of which have been obtained by the Challenger, and have been described in the first part of the present Report (Plumularidæ, p. 34, pl. x.). That the stinging property which can thus make itself so severely felt even by the human subject must here reside in the thread-cells will scarcely admit of doubt. Indeed there is no other part of the Hydroid to which it can with any reason be attributed.

The thread-cells of the Hydroida, though almost exclusively confined to the ectoderm, are by no means uniformly distributed in it. They are as a rule most

[1] N. Kleinenberg, *loc. cit.*
[2] Carl F. Jickeli, *loc. cit.*
[3] C. Semper, Reisebericht, *Zeitschr. f. wiss. Zool.*, Bd. xiii.

abundant in the tentacles of both hydranth and Medusa. In such tentacles as possess a terminal enlargement or capitulum (*Coryne*, *Syncoryne*, &c.) they are especially accumulated in this enlargement. In the marginal tentacles of many Hydromedusæ, they form condensed verticillate groups regularly distributed from distance to distance along the length of the tentacle, to which they give a moniliform character. In such cases the tentacle usually terminates in a spherical enlargement which is loaded with thread-cells.

In certain other Medusæ, which are also derived from hydroid trophosomes, we meet with special arrangements of the thread-cells. Thus in the Medusa of *Gemmaria implexa*[1] we find four superficial pyriform chambers extending from the umbrella margin in the outer ectodermal wall of the umbrella, and filled with thread-cells which doubtless originate in the walls of these ectodermal chambers, and thence apparently fall into their cavities. The marginal tentacles of this Medusa give rise along their entire length to filaments endowed with great powers of extension and retraction, each carrying on its summit an oval ciliated sac filled with thread-cells. In the Medusa of *Podocoryne carnea* each of the four lobes into which the mouth of the manubrium is here divided carries a pencil of non-contractile filaments, each of which bears on its extremity a solitary capsule resembling a cnidocyst, with its cnidocil and contained thread-cell. We can scarcely avoid a comparison of these naked pedunculated cnidocyst-like bodies with the cnidocysts as they elsewhere occur embedded in the ectoderm with their basal filiform prolongations.

In *Sertularia exserta* (Pl. XXVII. fig. 1*a*), one of the new forms obtained by the Challenger, small thread-cells are accumulated in a little cushion-like prominence at the base of every tentacle (figs. 1*b*, 1*c*). In this species the hydranth presents the very exceptional character of remaining in a state of habitual extension beyond the protective covering of the hydrotheca, and the batteries of thread-cells thus disposed would seem to have as their object a compensation for the loss of the protection which in most other Calyptoblastic Hydroids is afforded by the hydrotheca.

In certain Hydromedusæ (Trachomedusæ and Narcomedusæ, see below, p. xxix) thread-cells are accumulated on the umbrella margin which they surround in the form of an urticating ring, while in most of these Medusæ accumulations of thread-cells forming narrow urticating patches stretch from the umbrella margin in a meridional direction to the roots of the tentacles, which here spring from the dorsal surface of the umbrella at some distance from the margin.

Ganglion Cells.—Quite recently Jickeli has called attention to certain ectodermal cells which he has found widely distributed in the trophosome of many Hydroids, where they lie scattered between the deeper ends of the other ectodermal cells.[2] He describes

[1] Gymnoblastic Hydroids, p. 291, pl. vii.

[2] Carl F. Jickeli, *Morphol. Jahrb.*, Bd. viii.

them under the name of ganglion cells, and regards them as representing a differentiated nervous system. As seen in the tentacles of *Eudendrium ramosum*, they appear as well-defined nucleated masses of protoplasm, which send off outrunning tapering processes, usually three in number, and which under treatment with osmic acid appear thickly filled with black granules. Many of the outrunners, which the ganglion cells send off in the tentacles, unite with one another so as to form a plexus, while others lose themselves between the muscle fibrillæ, but no indubitable connection between nerve fibre and muscles has been found. Others again run to the thread-cells, and probably end close upon the cnidocil.

In other parts of the hydranth the form of these cells is less definite, and here they usually become accumulated in small heaps which lie between the ectoderm and mesosarc, and from which at most a single process is sent off to run between the ectoderm cells. Jickeli has sometimes seen a filament running between the ectoderm cells to a very minute cell with dark granular protoplasm and small elongated nucleus. He regards this as a "sense cell." Besides this mode of peripheral termination he believes that he has also seen one in the form of free nerve endings.

The ganglion cells also occur in great profusion in the cœnosare. Nothing, however, has anywhere been seen in any Hydroid trophosome which could with any probability be regarded as a specially differentiated nervous centre.

Gland-Cells.—In some places certain cells of the ectoderm appear to act as gland-cells. Such cells have been described by Weismann in some species of *Eudendrium*, where they form a complete ring round the base of the hydranth. They consist of a firm protoplasm which readily takes up colouring matter.

In *Tubularia larynx* and some other species of *Tubularia* a bowl-shaped accumulation of cells, which forms a projecting collar, crowns the stem immediately below the hydranth like the capital of a pillar.[1] The cells composing this collar may also be regarded as gland-cells. A glandular function may also be attributed to peculiar elongated cells with a radial disposition which form the aboral extremity of the Actinula or free larva of *Tubularia* and of *Myriothela*. There can be little doubt that these cells are destined to give origin to an excretion by which the Actinula becomes fixed at the close of its free locomotive existence. Cells of a similar nature would seem to be present in the aboral extremity of *Hydra*.

Sarcostyles.—In connection with the ectoderm, perhaps more appropriately than elsewhere, may be described certain very remarkable zooids which are found throughout the whole of the Plumularinæ, where they occur in the form of minute fleshy outgrowths which are contained in cup-shaped or tubular appendages of the stem, and are in direct communication with the cœnosarc.

To these bodies special attention was called by Busk, who described them under the

[1] Gymnoblastic Hydroids, p. 407, pl. xxi. fig. 5.

name of "nematophores" and insisted with justice on the differences presented by them as affording characters of primary importance in the systematic distribution of the Plumularinæ. Since then, however, our knowledge of these zooids has been greatly extended, and we now know that the character which the term nematophore was intended to express is one to which they can lay no special claim. I shall, therefore, not only on this account, but more especially because the term nematophore involves two conceptions which ought to be kept separate, namely that of the fleshy outgrowth and that of the receptacle in which this is contained, adopt here the terminology proposed by Hincks, and use the term *sarcostyle* for the fleshy offset from the cœnosarc, and that of *sarcotheca* for the chitinous receptacle by which this is protected.

The sarcothecæ occur in the Plumularinæ under two principal forms; (1) in that of fixed cups or tubes which are adnate by the greater part of their sides or by a broad base to the stem of the Hydroid; and (2) in that of cups which have no adhesion to the stem except at the very narrow point of origin, on which they are movable. Both kinds are very constant in their form and position. Under the name of nematophore they are specially described in the introductory remarks on the Plumularinæ of this Report.[1]

The contents of the sarcothecæ are very remarkable. Many years ago I drew attention to the fact that the bodies contained within the sarcothecæ had the faculty of emitting pseudopodia-like processes, which often extend to a great distance, running out free into the surrounding water or running straight along the stem or winding around it, frequently sending off branches which may become fused, one into the other, and again become separate, while once more the whole might be seen to have withdrawn itself into the interior of the sarcotheca. The phenomena thus presented so exactly resemble the emission of pseudopodia by certain Rhizopods that I came to the conclusion that the contents of the sarcothecæ consist chiefly of free protoplasm as in the body of an *Amœba*, though often with true thread-cells immersed in it.

Subsequent researches have, however, tended to modify this view, and the employment of the method of staining has led to the belief that the sarcostyles are of a more complex structure than I had originally supposed. By the use of this method Weismann believes that he has made it evident that the sarcostyles are composed of cells; further, that they are not a mere ectodermal outgrowth, but that besides having an external ectodermal layer they contain a solid filiform axial process from the endoderm, surrounded by a closed sac-like extension of the mesosarc.[2]

Since I became acquainted with these views I have had no opportunity of subjecting to fresh observation the conclusions to which I had been originally led, but any opinion

[1] *Kirchenpaueria* is the name of a genus which has been recently defined by Jickeli from some fragments of a Plumularian trophosome, in which certain sarcostyles are developed without being enclosed in sarcothecæ. The naked sarcostyles are here protruded through simple orifices in the perisarc of the stem (Jickeli, *loc. cit.*, p. 645).

[2] Weismann, Die Entstehung, &c., p. 176, pl. vii. fig. 7.

expressed by so excellent an observer as Weismann must command attention. Whether, however, the protrusible portion of the sarcostyle consists of a simple mass of protoplasm, or shows a differentiation into separate masses in the form of cells, is of little morphological or physiological importance, for such masses must be as destitute of a boundary membrane as the single protoplasmic mass in order to allow of their being the source of the pseudopodial extensions by which the sarcostyle is characterised.

While the views of Weismann have been in most points confirmed by the observations of Jickeli, a view somewhat different is taken by Mereschkowsky,[1] who believes that the sarcotheca contains an extension of the ectoderm, the cells of which do not lie close on one another, but leave between them spaces which are filled by a free protoplasm; and such a structure would be quite in accordance with the phenomena observed in the living animal.

We have, however, already seen that the ectoderm, in the modified condition which it often presents in the cœnosarc, may show an entire obliteration of cell boundaries and may throw out processes having many of the characters of true pseudopodia, and it needs but a further modification of this layer, consisting in a still lower grade of degradation towards the condition of undifferentiated protoplasm, in order that it may possess the faculty of emitting pseudopodia to the extraordinary extent which we meet with in the sarcostyles of the Plumularinæ; so that even though all the three body layers be present in the sarcostyles, we shall have in these appendages a portion which can scarcely be distinguished from undifferentiated protoplasm. If this portion be not free protoplasm it must be sought for in the ectoderm, for unless we are prepared to admit not only of an amœboid condition of the endoderm but of such a soft gelatinous consistence in the mesosarc as will allow of an indefinite extensibility in this membrane, we cannot believe that the endoderm and the mesosarc follow the pseudopodial outrunners of the sarcostyle.

Bodies in all essential points comparable with the sarcostyles of the Plumularinæ occur also in other Hydroids, and some very remarkable examples of these will be found in species first made known by the explorations of the Challenger. In *Perisiphonia*, one of the new genera of the Challenger collection, the peripheral tubes by which the axial hydrotheca-bearing tube is surrounded carry upon their outer sides multitudes of minute tubular cups whose finely granular contents admit of being protruded, as in the Plumularian sarcostyles, into the surrounding water (Pl. XXI. figs. 2*a*, 2*b*; Pl. XXII. fig. 2*a*); while in the singular and beautiful genus, *Diplocyathus*, a form nearly allied to *Halecium*, and also one of the discoveries of the Challenger, every hydrotheca is accompanied at its base by a similar tubular cup with protrusible contents (Pl. VIII. figs. 2, 3).

Whatever be the nature of the sarcostyles we must regard these bodies as true

[1] Mereschkowsky, Structure et Développement des Nematophores chez les Hydroides, *Arch. de Zool. Expér.*, t. x. p. 583.

zooids, "individuals" or "personæ," having devolving on them as their role in the physiological division of labour among the various zooids some special office which is probably that of aiding the hydranths, by their amœboid prehension of solid matter, in the general nutrition of the colony.

The Ectoderm of Myriothela.—The curious Gymnoblastic genus *Myriothela* has been already more than once referred to as possessing exceptional points of structure. The ectoderm especially presents so many points of interest and significance that no exposition of Hydroid structure would be complete without some special account of it.[1]

The ectoderm of *Myriothela phrygia*, the only known representative of the genus, is composed of two distinct strata—a superficial and a deep. The superficial stratum consists of small round cells, several in depth. These are formed of membraneless protoplasm, and contain throughout the greater part of the body abundance of yellowish corpuscles, while on the summits of the tentacles and in irregular patches on other parts of the body the superficial cells contain granules of a dark brownish-purple colour. In this layer large and small thread-cells may be seen enclosed in their generating cells or cnidocysts, for the most part lying near the surface.

The deep layer of the ectoderm is formed by a very remarkable tissue to which I have elsewhere given the name of "claviform tissue."[2] This is composed of cells consisting of a yellowish granular protoplasm, entirely destitute of membrane, and each drawn out into a long caudal process. An obvious nucleus may frequently be seen in them. By the union of their caudal processes branched groups of claviform cells are produced, and the common stalk of each group runs to the hyaline mesosarc, where it loses itself among the fibrillæ, which here form a well-marked muscle layer. The whole forms a soft, pulpy, and somewhat glandular-looking tissue easily broken down under the compressorium.

If we except the condition of the long transitory arms of the Actinula or free locomotive stage of *Myriothela*, the claviform tissue does not come to the surface of the body. Throughout the whole of the body of the adult it forms a deep zone intervening between the hyaline mesosarc and the superficial layer of the ectoderm.

In *Myriothela* the ectodermal musculature is well developed. It forms a well-marked layer of longitudinal fibrillæ closely applied to the outer side of the mesosarc, from which, after a short maceration in water, it may be separated as a continuous plate composed of fibrillæ which adhere to one another by their sides, forming a stratum of a single fibril in thickness. The fibrillæ are about $\frac{1}{12000}$ of an inch in diameter, soft and compressible, with a very finely granular structure, but otherwise apparently homogeneous. They show no striation, no nucleus can be detected in them, aud they admit of being traced to a considerable distance without showing any tendency to taper away in the manner of true muscle cells.

[1] For a detailed account of the structure of *Myriothela*, see *Phil. Trans.*, vol. clxv. pt. ii.

[2] Structure and development of Myriothela, p. 553, pl. lvi. fig. 6, &c.

It has just been said that the caudal prolongations of the clavate tissue may be traced into the fibrillated layer, but I have not succeeded in satisfying myself that the fibrillæ are directly continuous with these prolongations, as Kleinenberg has shown to be the case with the ectodermal fibrillæ of *Hydra*, in their relations to the caudate ectodermal cells of this genus, which, notwithstanding their superficial position, admit of an obvious comparison with the clavate tissue of *Myriothela*.

The general structure of the ectoderm of *Myriothela* is that now described. In the globular capitula, however, which terminate the tentacles, we have a most singular modification of those structures which lie external to the hyaline mesosarc. Here the place of the caudate cells is taken by a remarkable tissue, composed of closely appressed transparent prisms, or, to speak more exactly, of greatly elongated pyramids, which are attached by their apical ends to the mesosarc of the capitulum, and thence radiating outwards, terminate at some distance within the outer boundary of the capitulum in a convex surface, which slightly exceeds that of a hemisphere in extent. The whole body thus formed by this columnar tissue caps the hyaline mesosarc and subjacent endoderm of the summit of the tentacle.

Radiating from its convex surface, a multitude of cnidopods may be seen. These make their way among the cells of the ectoderm, and terminate distally at a short distance within the surface of the capitulum, where each carries on its summit a peculiarly modified large thread-cell with its enclosing cnidocyst. The cnidocyst carries close to its distal end a well-developed cnidocil, and is completely filled by the firm refringent capsule, within which may be seen a transparent cylindrical chord wound in two or three coils. The capsule is easily liberated from its enveloping sac, and under slight pressure the contained chord may sometimes be ejected through its distal end. The whole assemblage of sacs, with their included capsules, forms a zone parallel to the surface of the capitulum and a little within it.

Notwithstanding the indubitable relationship of the bodies just described to ordinary thread-cells, they differ from these in some important points which would lead us to believe that some function has been assigned to them, which is not that of the defensive or offensive office of the thread-cell.

The difference between them and the thread-cells, as usually seen in the Hydroida, is sufficiently obvious. The included chord does not, like the filament of an ordinary thread-cell, consist of a wider portion continuous with a narrower one, which during ejection becomes evaginated through the wider, but on the contrary possesses a uniform diameter considerably greater than that of the filaments of the typical thread-cell, and instead of presenting, as in the latter, a vast multitude of coils rolled together into a regular spiral or into a complicated mass it has only two or three such coils. Further, when ejected from the capsule—while it still holds on by one end to the point of exit—it does not, like the filament of an ordinary thread-cell, straighten itself, and shoot across the field of the microscope, but immediately on becoming free coils itself again into a

spiral, while it is entirely destitute of the barbs or spines which constitute so characteristic a feature in the typical thread-cell.[1]

It is scarcely possible to avoid suspecting that these capsules with their associated structures, differing as they do from ordinary thread-cells, are destined for the performance of some sensory function.

The claviform tissue which is developed in the deeper parts of the ectoderm, and which is as we have seen in intimate relation with the muscular layer, is obviously comparable with the caudate cells of Kleinenberg's neuro-muscle layer, and its deep position in the ectoderm will scarcely detract from the weight of this comparison when we bear in mind that the necessary stimulus may be carried to it through the cells which form the thin layer of ectoderm with which it is covered. There can be little doubt that the rod-like tissue into which the stalks of the capsules may be traced is a special modification of this claviform tissue, while it forcibly recalls the nerve-rods in the sense organs of higher animals. Though all the necessary connections of the parts have not yet been demonstrated, we see enough to make us believe that it is at least probable that the various structures here associated represent an apparatus for the reception and transmission of impressions received from without.

Another very exceptional condition is seen in the presence of a well-marked layer of circularly disposed muscular fibrillæ, which are developed in the ectodermal coat which lies immediately on the generative mass in the gonophore of *Myriothela*, and by contraction of which the contents of the gonophore on attaining maturity are expelled.

3. *The Mesosarc.*

Attention was first called to the existence of this layer in the Hydroid body by Reichert, who described it under the name of "Stützlamelle."[2] It is in its normal condition a perfectly hyaline structureless membrane which everywhere intervenes between the endoderm and the ectoderm, entering the tentacles along with these layers, and forming a cul-de-sac in the summit of each. It not only separates the peculiar chorda-like endodermal tissue of the tentacular axis from the surrounding ectoderm, but sends off at the base of the tentacle a layer which separates the chorda-like tissue from the proper digestive endoderm. The longitudinal muscular fibrillæ of the ectoderm lie in close apposition with its outer surface. Its thickness may in some places be seen to be traversed by very delicate fibrils, which run vertically to its surfaces and form a connection between the two body layers, ectoderm and endoderm, which it separates from one another.

In *Monocaulus imperator*, the gigantic Tubularian brought up by the Challenger

[1] Jickeli has described in *Hydra* certain small thread-cells whose filament on ejection remains coiled in a way very similar to that here seen.

[2] Carl B. Reichert, Über die contractile Substanz und ihre Bewegungs-Erscheinungen, Berlin, 1867.

from a depth of nearly four miles in the North Pacific, the place of the mesosarc appears to be taken by a very remarkable layer, whose most striking character is its extraordinary elasticity (see p. 7). It is comparatively thick, and has a distinctly fibrous structure, the fibres running in a circular direction, and being themselves resolvable into finer fibrillæ (Pl. III. figs. 4, 6). Nothing, however, approaching to a true organisation can be detected in this layer, and we shall be probably justified in regarding not only the mesosarc as it elsewhere occurs, but this remarkable modification of it, as an excreted product of the endoderm, as the perisarc is of the ectoderm.

The clear gelatinous substance which forms the principal part of the umbrella in the Medusa must be regarded as representing the mesosarc. In the Hydromedusæ it takes the place of that portion of the mesosarc which lies on the dorsal or exumbrellar side of the radial canals and "endoderm lamella"; while on the ventral or subumbrellar side the mesosarc retains its character as a thin elastic membrane which lies just within the subumbrellar ectoderm and supports the muscular swimming plate. In such Medusæ as are developed directly from the egg, it can be seen to be deposited as an excretion between the ectoderm and the endoderm of the larva, where it holds exactly the place of the mesosarc. (See below, p. xxxvii).

4. *The Perisarc.*

The perisarc affords some of the most obvious diagnostic characters of the Hydroida, and being frequently the only part preserved in dead specimens becomes of much practical value in the identification of species, and even of higher groups.

Except in the case of the Hydractininæ and Hydrocorallia it is the most external of all the layers which enter into the formation of the Hydroid body. Like the mesosarc it shows no trace of organised structure; and like that membrane it must be regarded as a simple product of excretion.[1] It is, however, in almost every case much more massive than the mesosarc and often attains a very considerable thickness, showing by its laminated structure indications of its formation by successive deposits from within. As the mesosarc would seem to be an excretion from the outer surface of the endoderm, the perisarc must be regarded as an excretion from the corresponding part of the ectoderm. It shows a remarkable resistance to the action of chemical reagents, which with the exception of the strong acids are usually without any effect on it. In this character as well as in its chemical composition it would seem to be closely allied to chitin, if it be not identical with this substance which forms the principal constituent of the external skeleton of insects and other Arthropoda.

With the exception of *Hydra*, and possibly some doubtful forms (*Nemopsis*, *Acaulis*), there are no Hydroid trophosomes in which the perisarc is not to some extent represented,

[1] Jickeli believes that in some cases (*Tubularia mesembryanthemum*) he has found it to be formed by an induration of the ectoderm.

though in a few its formation takes place on so insignificant a scale as to render its presence liable to be overlooked. In the Hydrocorallia it is replaced by an internal hard calcareous corallum. In by far the greater number of cases it constitutes a firm protective tube by which the cœnosarc is invested, while in the great primary section of the Calyptoblastea, it is continued for a greater or less extent, and in a more or less modified form, over the various zooids of the colony. In these it forms the cup-like receptacles or hydrothecæ into which the hydranths can become retracted, as well as the peculiar receptacles—gonangia—destined for the protection of the generative buds (Pl. X. fig. 2*a*; Pl. XII. fig. 1*a*; Pl. XXIV. fig. 1*a*; &c.). In the Gymnoblastea, on the other hand (Pl. III.), neither of those protective extensions of the perisarc exists. In two very remarkable genera, *Synthecium* and *Thecocladium*, fine examples of which have been brought home by the Challenger, another function besides that of the protection of the hydranth would seem to devolve on certain hydrothecæ. In *Synthecium* some of the hydrothecæ situated on definite parts of the colony contain no hydranths, but on the other hand enclose, each, the peduncle of a gonangium which springs from the bottom of the hydrotheca (Pl. XXXVII. fig. 1*a*, &c.). In *Thecocladium*, again, every branch of the colony springs from within a hydrotheca, which thus, instead of containing a hydranth, encloses as in a sheath the proximal end of the branch (Pl. XXXVIII. fig. 3). The perisarc varies greatly in thickness, from a strong coat in which numerous layers of deposition may be seen, to a delicate, scarcely recognisable pellicle, and is invariably absent from those zooids which have detached themselves from the colony in order to lead an independent life in the open sea.

While the cœnosarc of the Hydroid colony is, as an almost universal condition, protected by an external perisarcal tube, an exception to this condition is found in *Hydractinia* and *Podocoryne* as well as in the entire section of the Hydrocorallia. In *Hydractinia* and *Podocoryne* the chitinous perisarc forms a continuous thick stratum permeated by a network of anastomosing cœnosarcal tubes, and overlaid by a naked extension of the cœnosarc. In the Hydrocorallia the calcareous corallum, which here forms the hard skeletal tissue of the colony, and is also permeated by anastomosing tubes of cœnosarc, is in a similar way overlaid by a superficial covering of cœnosarc. Indeed the relations between the *Hydrocorallia* and *Hydractinia* are in many respects of the most intimate kind.

V. The Gonosome.

The various zooids and associated structures now described are more or less directly connected with the nutrition of the colony, and may, as has already been said, be collectively designated by the name of *trophosome*. There are, however, other parts of the colony on which a different group of functions—namely, that of sexual reproduction

—specially devolves, and though, as we shall presently see, the formation of the sexual elements is far from being in all cases dissociated from the trophosome, we may conveniently designate collectively all those parts which have special charge of the protection and development of these elements, as the *gonosome*.[1]

1. *The Gonophore.*

The most important zooid of the gonosome is the gonophore, as the hydranth is that of the trophosome. Its office is to give protection to the sexual elements—ova or spermatozoa—and to bring these to a more or less advanced stage of maturity before their final liberation.

Throughout the whole of the Calyptoblastic Hydroids, and in many of the Gymnoblastic, the gonophores are produced as buds from the sides of a column-like body which springs from the cœnosarc. This body is morphologically a hydranth with its tentacles and mouth suppressed. It is known as the *blastostyle*, and in the Calyptoblastea is contained within a protective capsule-like chamber, which has its walls lined with perisarc, and is known as the *gonangium*.

In the Gymnoblastea the gonophores are more usually borne as buds directly by the cœnosarc without the intervention of a blastostyle, but whether a blastostyle be present or not, they are in this section never protected under cover of a gonangium.

The gonophores may be divided into two main groups. In one of these, after it attains a certain degree of maturity, the gonophore becomes detached from the colony, leads henceforth an independent, locomotive life, and after bringing its sexual products to maturity discharges these into the open sea. To the gonophores belonging to this group the name of *planoblasts* (wandering buds) may be given.

In the other group the gonophores never become detached, but discharge their sexual products while still forming part of the colony. The gonophores belonging to this group may be distinguished by the name of *hedrioblasts* (sedentary buds).

Form and Structure of the Planoblast.—The planoblasts are all, with a single known exception,—that presented by *Dicoryne*, in which the planoblast is a ciliated tentacula-bearing sac [2]—velum-bearing Medusæ (Craspedotæ or Hydromedusæ).[3] In form

[1] The sarcostyles do not belong exclusively to either of these systems, and we have both trophosomal and gonosomal sarcostyles.

[2] Gymnoblastic Hydroids, p. 292, pl. viii.

[3] The most obvious character of all Medusæ consists in the presence of a gelatinous umbrella which acts as a swimming organ, and which carries at the centre of its lower or concave surface a more or less prominent gastral tube. The Medusæ are divided into two primary sections—the Craspedotæ (velum-bearing) or Hydromedusæ, and the Acraspedæ (without a velum) or Scyphomedusæ. The Craspedotæ, among which alone we find those Medusæ which admit of being traced in the course of their development to a Hydroid trophosome, differ fundamentally from the Acraspedæ. The most important points of difference by which the Craspedotæ are separated from the Acraspedæ are the following :—1. The possession by the Craspedotæ of a true velum which does not exist in the Acraspedæ. 2. The absence in the Craspedotæ of "gastral filaments" which are always present in the Acraspedæ where they spring from

they are bell-shaped, the walls of the bell or *umbrella* being mainly composed of a transparent substance of gelatinous consistence. From the summit of the bell-cavity hangs a tubular body of variable length,—the *manubrium*—whose distal or free extremity carries the mouth, and on whose cavity devolves the function of digestion. From the basis of the manubrium four (sometimes more) canals pass off and run in equally distant meridian lines in the walls of the umbrella towards its margin, where they open into a circular canal which runs quite round the margin of the umbrella. The opening (*codonostome*) of the bell-cavity is partially closed by a membranous diaphragm, the *velum*, which stretches across it from the margin, and is perforated in the centre by an aperture which allows the surrounding water to enter the bell, and through which it may be again expelled from within, while hollow contractile filaments or *tentacles*, which vary much in number in the different species, hang from the umbrella margin.

The umbrella is eminently contractile, and acts by alternate rhythmical dilatations and contractions (diastole and systole) of its cavity as a powerful organ of locomotion by which the planoblast is propelled through the surrounding water.

The external or convex, and the internal or concave, surfaces of the umbrella are clothed with a cellular epithelium—the representative of the ectoderm. Between these lies the thick elastic gelatinous substance traversed in meridional lines by the radiating canals, and in a circular direction by the marginal or circular canal. Both sets of canals have their walls lined with endoderm.

The researches of the Hertwigs[1] have shown that a thin lamina of endoderm exists in the intervals of the radiating canals, and connects these canals laterally with one another. This "endoderm lamella" represents the obliterated portion of the lumen which existed between the two layers of the double walls of an endodermal cup which was present in the early stages of the developing bud, while the radiating canals represent those portions of the lumen which have continued pervious (see below, p. xxxi).

The great contractility of the umbrella is due to a continuous muscular sheet which lies just under its concave or "subumbrellar" surface. The fibres of this muscular layer are transversely striated and seem to be derived from the epithelial cells. They take a circular course parallel to the umbrella margin. In some cases fascicles of meridionally disposed fibres are also present. A strong muscular layer also exists in the velum, where

the internal surface of the stomach-walls. 3. The absence in the Craspedotæ of true marginal lobes, into which the margin of the umbrella is divided in the Acraspedæ. 4. The fact of the sexual receptacles (genitalia) of the Craspedotæ discharging their contents externally into the surrounding water instead of internally into the cavity of the gastro-vascular system as in the Acraspedæ. 5. The possession by the Craspedotæ of a double marginal nerve-ring representing a centralised nervous system, while in the Acraspedæ where a nerve-ring has been demonstrated this is never double. 6. The fact of the polyp-form which shows itself in the course of the development of a Craspedote Medusa being a Hydropolyp destitute of gastral longitudinal ridges ("tæniola" in the strict sense of the word), while in the Acraspedæ it is a Scyphopolyp or polyp-form with gastral tæniola. 7. The fact of the Craspedote Medusa being formed by lateral budding from its Hydroid trophosome, while the Acraspedote Medusa is formed by terminal budding from its Scyphopolyp.

[1] O. und R. Hertwig, Das Nervensystem und die Sinnesorgane der Medusen, Leipzig, 1878.

it forms the principal thickness of this membrane. Its fibres take a circular course, parallel to the margin of the umbrella.

The manubrium presents the ordinary typical structure of the Hydroid body, its walls being composed of the two cell-layers, ectoderm and endoderm, with an intervening structureless membrane, the mesosarc ; on the ectodermal side of the mesosarc lies a layer of longitudinal muscle fibres.

The nervous system attains in the planoblast a stage of development more highly advanced than that presented by this system in the trophosome. In the planoblast it consists in its principal portion of two chords which run round the margin of the umbrella, one on the upper, and the other on the lower, side of the line of insertion of the velum. They are composed of fibres and ganglion cells, and are overlaid by a sense-epithelium whose cells carry sense-hairs. The organs of sense are situated on the margin of the umbrella and are chiefly of two kinds; of these one consists mainly of accumulations of pigment cells. These are placed each at the base of a marginal tentacle, and are entirely confined to the ectoderm. They occasionally enclose a clear refringent spherule. To this form of sense organ the name of *ocellus* has been given. The other consists of transparent vesicles, within which are one or more cells with calcareous concretions or "otolites." They also enclose so-called "auditory cells," whose hairs surround the otolite cells. They are seated in variable number immediately over the marginal nerve-ring, and on the portions of the margin which lie between the bases of the tentacles.[1] They are known as *otocysts*. The otocysts like the ocelli are entirely ectodermal, and must be regarded as a special differentiation of the epithelium which covers the nerve-ring.

The generative elements are developed either in the walls of the manubrium or along the course of the radiating canals. Those planoblasts in which the generative elements are found in the walls of the manubrium belong to the section Anthomedusæ and have the marginal sense organs, when differentiated, in the form of ocelli, while those in which the genitalia are borne in some part of the course of the radiating canals belong to the section Leptomedusæ, and have the sense organs in the form either of otocysts or of ocelli.[2]

[1] In *Obelia* the otocyst is in contact with the base of the tentacle, but even here it does not lie in the meridional line of this, but is placed laterally, and thus really lies in the inter-tentacular spaces of the umbrella margin. The *Obelia* planoblast is further exceptional in having its umbrella so shallow as to be almost disc-shaped, in the velum being rudimental, and in the marginal tentacles having their roots plunged into the substance of the gelatinous umbrella, being comparatively rigid, and having their axis occupied by a solid endodermal core. In the characters thus presented by the tentacles *Obelia* shows an obvious approach to the Trachomedusæ and Narcomedusæ.

[2] I adopt these names as proposed by Haeckel for the two groups indicated by them, in preference to the names, Ocellatæ (=Anthomedusæ), and Vesiculatæ (=Leptomedusæ), by which these groups have also been designated, the characters expressed by the latter names not being always applicable to the Medusæ to which they are intended to apply. Haeckel divides the Craspedotæ into two primary sections, the Leptolinæ and the Trachylinæ, the former being further divided into the Anthomedusæ and the Leptomedusæ, and the latter into the Trachomedusæ and the Narcomedusæ. The Anthomedusæ among the Leptolinæ, and the Narcomedusæ among the Trachylinæ, are distinguished by having their gonads in the walls of the manubrium ; the Leptomedusæ among the Leptolinæ, and the Trachomedusæ among the Trachylinæ, by having them in the course of the radiating canals.

In every case, with a single recorded exception, when the planoblast referable to the type of the Anthomedusæ has been traced to its trophosome, this is found to belong to the Gymnoblastic section of the Hydroida; while in every case—also with a single recorded exception—the trophosome to which the planoblast of Leptomedusal type has been traced belongs to the Calyptoblastic section.

The exception in the former case is found in *Leptoscyphus tenuis*, a minute Campanularian Hydroid to which I believed myself justified in referring a little Medusa found free in the jar in which a specimen of *Leptoscyphus* was confined, and which, though it had not yet attained sexual maturity, was an undoubted Anthomedusa referable to the form to which Edward Forbes gave the name of *Lizzia*.[1]

The exception in the second case occurs in a Tubularian Hydroid described by Claus under the name of *Campanopsis*, the planoblasts of which are referred by him to the form known as *Octorchis*, which is a Leptomedusa bearing otocysts on the margin of the umbrella, and having its gonads or sexual pouches formed in the walls of the radiating canals.[2]

While every planoblast—with the exception of that of *Dicoryne*—is thus a true Craspedote Medusa, it is not among all groups of the Craspedotæ that planoblasts—confining this term to the free sexual buds thrown off from a polypoid trophosome—can be found. There are certain Craspedote Medusæ (Trachomedusæ and Narcomedusæ) which, though possessing like all the Craspedotæ a true Hydroid structure, have not yet been known to give rise in the course of their development to a Hydroid trophosome or polyp stage, and are probably all developed directly from the egg of the parent Medusa.[3] They are distinguished by certain well-marked characters from the other Craspedotæ (Anthomedusæ and Leptomedusæ) among which alone we find the planoblasts. The most important of these characters consists in the ectodermal otocysts of the Leptomedusæ being here replaced by peculiarly modified tentacles in the form of short club-shaped appendages which lie either free on the umbrella margin or are each enclosed (part of the Trachomedusæ) in a special vesicle formed by an ectodermal fold sent off from the epithelial covering of the marginal nerve-ring. They have a solid endodermal axis, in certain cells of which calcareous concretions (otolites) are formed, while the ectoderm carries stiff "auditory bristles." To these marginal clubs an auditory function has accordingly been attributed.

Both Trachomedusæ and Narcomedusæ are also characterised by the comparative rigidity of their marginal tentacles, which are originally always provided with a solid chorda-like axis instead of being hollow as is almost always the case with the marginal tentacles of the Anthomedusæ and Leptomedusæ. The margin of the umbrella is further distinguished by being surrounded by an urticating ring formed by an accumulation of thread-cells.

[1] Allman, *Ann. and Mag. Nat. Hist.*, May 1864. [2] Claus, *Arb. Zool. Inst. Wien*, Bd. iv.

[3] Unless the fresh-water Medusa, *Linnocodium*, should prove an exception; see A. G. Bourne, *Proc. Roy. Soc. Lond.*, vol. xxxviii. p. 9, 1884.

In many Trachomedusæ, and in almost all Narcomedusæ, the marginal tentacles present the remarkable phenomenon of having migrated upwards on the dorsal surface of the umbrella from their original points of attachment close to the margin, so that they finally spring from a zone at some distance from the umbrella margin, with their roots plunged into the substance of the umbrella. In such cases accumulations of thread-cells form meridional urticating streaks ("umbrella clasps" or "peronia" of Haeckel) by which the bases of the tentacles continue to be connected with the marginal urticating ring.

Comparison of the Medusa with the Hydranth.—The Craspedote Medusa as seen in the planoblast, however different its form may appear from that of the Hydropolyp as seen in *Hydra* or in the hydranth of the compound trophosome, may nevertheless be easily reduced to this fundamental type form.

If we suppose the body of *Hydra* to be extended laterally in a plane immediately behind the hypostome, and on a level with the tentacular verticil, carrying between its upper and lower surfaces an extension of the body cavity, a hollow disc will be thus formed, having the tentacles springing from its margin, and with the hypostome which carries the mouth projecting from its centre. If now its upper and lower walls coalesce with one another throughout their entire extent, except along four or more radial lines running from the gastral cavity to the tentacular margin, there will result a disc traversed by radiating canals and margined by tentacles. This disc will manifestly represent the umbrella of a Medusa with its radial canals and marginal tentacles, while the hypostome will correspond to the manubrium; and it only needs the distal ends of the radiating canals to become united to one another by the formation of a circular canal, and the proximal stem-like extension of the *Hydra* with its disc of attachment to be suppressed in order to convert the polyp form in all essential points into the Medusa form. The Medusa is thus nothing but a hydranth whose body-walls are extended in the form of an umbrella with offsets from the gastral cavity, and act as an organ of natation.

Form and Structure of the Hedrioblast.—The hedrioblasts or gonophores, which never become detached from the trophosome as free-swimming zooids, are in the form of fixed sac-like buds. Of these two types must be distinguished. In one the medusoid conformation, however degraded, is yet sufficiently expressed to admit of its being recognised, the essential parts of the umbrella, including the endoderm lamella or "vascular lamella," being always present even though no gastrovascular canals may have been formed in it. In the other neither endoderm lamella nor gastrovascular canals have been formed, and the umbrella is represented solely by its outer ectodermal layer, which here lies directly on the spadix or endodermal *cul de sac* which forms the hollow axis of the gonophore. The first of these varieties of the hedrioblast is known as the *medusoid*, the second as the *sporosac*.

An intermediate form by which the medusoid passes into the fully developed Medusa is seen in *Pennaria*. Here the umbrella has four well-developed radial canals which open into a marginal circular canal, while its codonostome, though never attaining the widely open condition found in the planoblast, and carrying on its margin only the rudiments of tentacles, is sufficiently developed to admit of the free ingress and egress of the surrounding water. Notwithstanding, however, this relatively advanced stage of development, the gonophore remains permanently attached to the trophosome, and thus discharges its generative products without ever becoming free.[1]

Development of the Gonophore.—In the development of the Medusa-bud, the first foundation of the Medusa, like that of every bud in the Hydroid colony, consists of an outbulging of some definite part of the Hydroid body. There is thus formed a sac-like projection whose walls consist of endoderm and ectoderm in direct continuation with the same layers in the colony, and whose cavity is also only an extension of that of the part from which the bud is given off.

The subsequent course of the development has recently been studied more especially by O. and R. Hertwig,[2] and by Weismann.[3] When the hernia-like sac which forms the foundation of the gonophore has attained a certain height the ectoderm of its summit becomes thickened and forms an internal prominence, the "Glockenkern" or *endocodon* of Weismann. This, pressing on the part of the endoderm which lies beneath it, causes an inversion of the endoderm in the form of a cup whose walls, necessarily double as the result of the invagination, rise on all sides round the endocodon. In the meantime a central cavity has been formed in the solid ectodermal endocodon. This is to become the cavity of the umbrella, while by the partial adhesion to one another of the two endodermal layers by which it is surrounded, four (or more) longitudinal channels are produced. These are the radiating canals, while the intervening endoderm, whose lumen has become obliterated by the adhesion, forms the endoderm lamella or vascular lamella of the Hertwigs.

At the same time the bottom of the endodermal cup rises in the form of a hollow cone, pushing before it the ectodermal layer which forms the floor of the cavity of the endocodon. It thus becomes clothed by this layer, and forms the manubrium of the Medusa with its endodermal and ectodermal layer, while the circular canal which in the Medusa runs round the margins of the umbrella is formed by intercommunicating lateral tubular offsets from the distal extremities of the radial canals. Finally, the cavity of the umbrella, still represented by the hollow endocodon, opens externally

[1] Another intermediate form between hedrioblast and planoblast has been recently described by Clarke (*Mem. Boston Soc. Nat. Hist.*, vol. iii., 1872) in a Gymnoblastic Hydroid from the American coast. In this, which gives origin to medusoids with well-developed radial and circular canals, Clarke has seen some of the medusoids detach themselves before liberation of their generative products, while others discharge these without ever becoming free.

[2] O. und R. Hertwig, Das Nervensystem und die Sinnesorgane der Medusen, Leipzig, 1878.

[3] A. Weismann, Die Entstehung, &c.

and places the interior of the umbrella in free communication with the surrounding water.

This account of the development of the Medusa-bud agrees in almost all points with that previously given by Agassiz, who regarded the radial canals of the umbrella as the result of the non-adhesion of the two layers of the endodermal cup along definite longitudinal lines, while it differs from the view formerly urged by myself, in which I regarded the radial canals as growing out in the form of tubular processes from the basis of the manubrium.

The theory of the formation of the canals by arrested adhesion of the two endodermal layers along the lines of these canals will satisfactorily explain the phenomena, and the truth of this explanation seems to be placed beyond doubt by the discovery of the endoderm lamella shown by the Hertwigs to exist as a persistent structure in the umbrella of the Medusa.

It must not be supposed, however, that radial canals are never formed by an outgrowth of tubes from the base of the manubrium into the walls of the umbrella. Though the primary canals may be always formed as described above, there are instances (*Æquorea*, &c.) in which the canals increase in number after the detachment of the Medusa, and in such cases it is certain that the newly formed canals extend themselves in the umbrella walls from the base of the manubrium in order to open into the circular canal round the margin.[1]

The formation of the medusoid also takes place through the medium of an endocodon, and is similar to that just described for the Medusa, except in the fact that the radiating canals are in most cases entirely suppressed, and that in those rare instances in which they may be seen in a rudimental or even completely developed form the umbrella does not present the wide codonostome of the Medusa, and is not developed so as to be employed as an organ of natation.

In the sporosac, on the other hand, the development does not take place through the formation of an endocodon, and no endoderm lamella being formed, the walls of the sac retain the condition presented in the early stages of the bud, being simply composed of two layers, an internal endodermal layer, and an external ectodermal layer, these two being subsequently separated by the presence between them of the generative products.

Between the medusoids and those gonophores, which as planoblasts have attained the condition of true Craspedote Medusæ, there is a close parallelism, the various parts in the one having their representatives in a more or less modified form in the other. In the medusoid, passing from without inwards, we meet with the following layers:—Most externally a layer of ectoderm; then a thin lamina of endoderm in which gastrovascular canals may or may not be developed, and which though present in the early stages of the bud is not always demonstrable in the mature gonophore. To this

[1] Gymnoblastic Hydroids, p. 79, fig. 35.

succeed two layers of ectoderm; and lastly, we meet with an endodermal layer surrounding a cavity which occupies the axis of the gonophore, and is in free communication with the general cavity of the colony.[1]

If we now compare this with the structure met with in the Medusa we shall find the external ectodermal layer to be homologous with the outer epithelial layer of the umbrella. The next ectodermal layer will represent the subumbrellar or inner epithelial layer of the umbrella, while the endodermal layer which intervenes between these two layers of ectoderm corresponds to the endoderm lamella in which are formed the radiating canals of the Medusa. The next layer is an ectodermal one and forms the external layer of a *cul de sac* which occupies the axis of the medusoid, and corresponds to the manubrium of the Medusa. This layer represents the ectodermal layer of the manubrium, while the inner or endodermal layer of the *cul de sac* corresponds to the endodermal layer of the manubrium of the Medusa.

When the generative elements make their appearance in the gonophore they are seen in the hedrioblasts to lie between the endoderm and ectoderm of the central *cul de sac* which corresponds to the manubrium of the Medusa; while in the planoblast they lie either between the corresponding layers of the manubrium, or between the endoderm and ectoderm of definite points in the course of the radiating canals.

The intervention of the generative products between the endoderm and ectoderm of the central *cul de sac* in the hedrioblast, necessarily separates these two membranes from one another, and the endodermal portion then extends in the axis as an elongated closed sac surrounded by the generative products, and known as the *spadix.*

2. *Origin of the Generative Elements.*

It had been always believed that the generative elements had their origin in the gonophores in which they constitute so conspicuous and characteristic a feature. It was therefore with no little surprise that during an examination of the common *Sertularia pumila* of our coast I found the walls of the blastostyle of this species loaded with nucleated cells which it was impossible to regard in any other light than as young ova. This condition I described with an accompanying figure, stating my belief "that the true gonophores bud forth from that part of the blastostyle in which the nucleated bodies occur, and that these as young ova pass from the blastostyle into the budding gonophore, where they would then naturally occupy their normal position between the endoderm and ectoderm of an organ representing the manubrium of a Medusa, destined

[1] I do not here include the layer to which in my original description of the gonophore I gave the name of "ectotheca," for though I never regarded this otherwise than as an external capsule-like covering of the true gonophore (see Gymnoblastic Hydroids, pp. 32, 33), I willingly accept the criticism of Weismann, who objects to its enumeration among the layers of the gonophore as misleading. Neither do I include in the account here given of the development and homologies of the gonophore the structureless mesosarc which must be understood as intervening between the ectoderm and endoderm, or the gelatinous excretion by which in the Medusa this is more or less completely represented.

to undergo there a further development before being discharged into the acrocyst," an appendage of the gonophore in the form of an external marsupial chamber which exists in certain species, and receives the ova before their final escape as larvæ into the surrounding water. I described the function of the gonophore in this case as merely that of "a receptacle in which certain intermediate stages of development take place."[1]

The phenomenon, however, thus recorded in *Sertularia pumila*, I believed to be peculiar to this species, with possibly a few others, and I thus overlooked its real significance. The important researches of Edouard van Beneden have since shown that the sexual cells may originate in other parts of the colony at a distance from the gonophore,[2] and Kleinenberg has made it evident that egg-cells which originate in the ectoderm may pass through the mesosarc into the endoderm, and there, surrounded by conditions better suited to their nutrition, may increase in size and make further advance towards maturity;[3] but it was reserved for Weismann by his epoch-making researches into the origin of the sexual elements in the Hydroida,[4] to show that what I had thus regarded as an exception was really the rule, and that the sexual cells originate in most cases in parts of the colony removed from the gonophore, into which they subsequently wander in order to pass through certain later stages of their development.

These remarkable researches of Weismann have shown not only the parts of the colony in which the sexual cells originate, but the special layers—endoderm or ectoderm —which give birth to them, and the unexpected fact has been elicited, that there is no constancy either in the part of the colony or in the particular tissue in which the germ cells, which are to become developed into spermatozoa or into ova, first show themselves.

The observations of Weismann have been made on a very large number of species, and he concludes that the sexual cells arise now here, now there, without rule or connection, and that their origin has no definite relation to the germinal layers of the embryo, that on the contrary, it is now the endoderm, now the ectoderm, now both layers together which give rise to them. Then again it may be the ectoderm which gives origin to the male, the endoderm to the female sexual cells, as is the case in *Campanularia flexuosa*, while in other instances, as in *Eudendrium racemosum*, it is the reverse of this. And not only does the relation of the sexual cells to the two primary layers thus vary, but their relation to the various zooids of the colony is equally without any apparent law; for in some cases the place of origin of these cells may lie in the manubrium of the Medusa, in others in the cœnosarc of the stem or branches, and now again in the buds which are to form sedentary gonophores. It would seem that every

[1] Gymnoblastic Hydroids, p. 150, woodcut fig. 21, p. 50.

[2] E. van Beneden, Sur la distinction originelle du testicule et de l'ovaire, *Bull. de l'Acad. Roy. de Belgique*, sér. 2, t. xxxvii.

[3] Kleinenberg, Die Entstehung der Eier bei Eudendrium, *Zeitschr. f. wiss. Zool.*, Bd. xxxv., 1881.

[4] August Weismann, Die Entstehung der Sexualzellen bei den Hydromedusen, Jena, 1883.

part of the colony may bring forth sexual cells, and that the elements of the two germinal layers (endoderm and ectoderm) may become transformed in one instance into male, in another into female, sexual cells.

So indefinite and independent of law is all this, that Weismann has been almost led to conclude that in the lowest Metazoa—the bilaminar Cœlenterata—no functional separation of the germinal layers has taken place such as we find in the higher Metazoa; that in those lowest forms both germinal layers possess the faculty of differentiating sexual cells out of their own elements, while it is in the higher Metazoa that this faculty has for the first time become concentrated on one of their three germinal layers.

At the same time it must be borne in mind that the part of the colony, as well as the special germinal layer in which the sexual cells originate, is fixed for each species.

Weismann has further pointed out that it is never cells already histologically differentiated which are transformed into sexual cells, but only those of young tissue, which are to a certain extent embryonal, or of no determinate external character.

Another fact of great importance, which seems to have been fully established by the researches of Weismann, relates to the manner in which the sexual cells which have originated elsewhere reach the gonophore in which they are to pass through further stages of development. These researches place it beyond doubt, that the sexual cells are carried into the gonophore, not by mere physical pressure, but that they wander from their place of birth by their own proper movements, such as might exist in amœboid protoplasm masses. In this way they move from place to place among the cells of the endoderm and ectoderm, and even pass from one layer into the other by actually perforating the mesosarc which separates these two layers from one another.

Shortly after arrival in the sedentary gonophore, whether this be a medusoid or a simple sporosac, the sexual elements—egg-cells or spermatozoa—are found accumulated round the spadix where they are retained by the *perigonium* or sac formed by the more external parts of the gonophore.[1] It is here that, in at least the great majority of cases, the influence of the male element is exerted on the egg-cells, but by what channel the spermatozoa gain access to them has not yet been satisfactorily determined.[2]

[1] The perigonium in the sporosac consists simply of the ectodermal coat which before the intervention of the sexual cells lay close upon the spadix, while in the medusoid it consists not only of this coat but of layers which correspond to those which form the umbrella of a Medusa.

[2] Under the name of *Hydrella ovipara*, Goette (*Zool. Anzeiger*, 1880) has noticed a minute Hydroid, of which he obtained a single specimen at Naples, and which would seem to be nearly allied to *Halecium*. In the atrophied and disintegrated cœnosarc of the stem were several nucleated cells, which he regards as eggs, and as no gonophores were present in the specimen, he believes that this Hydroid offers an instance of direct sexual reproduction without the formation of special generative zooids.

It is possible that Goette's interpretation may be the right one, and that here as in *Hydra* no true gonophores are developed; but when we bear in mind the very general presence of eggs in the Hydroid cœnosarc, as proved by the researches of Weismann, and the fact that in *Hydrella* the supposed egg-cells are irregularly scattered in the atrophied cœnosarc without any tendency to the localisation which we find in *Hydra*, we can scarcely avoid regarding the absence of a gonosome in the specimen as depending on the season of the year, on age, or on abnormal conditions, and cannot but

That form of gonophore which presents the condition of a free Medusa or planoblast, has like the sedentary gonophores the office of bringing to maturity the sexual elements. In almost all these, however, the sexual products arise within the Medusa, and do not therefore need to migrate from a distance into their place of maturation.

In those planoblasts whose generative elements are borne along the course of the radiating canals (Leptomedusæ) that part of the walls of the canal in which these are contained usually projects with the included ova or spermatozoa into the cavity of the umbrella in the form of a pouch or gonad, which has often the appearance of a distinct gonophore budded off as an independent zooid from the canal. I formerly regarded it as such and made this view the grounds for separating the planoblasts into such as give origin to their sexual elements directly in the walls of the manubrium (gonochemes = Anthomedusæ), and such as produce them only through the intervention of a special sexual bud (blastochemes = Leptomedusæ). I now, however, believe it more correct to regard the sexual pouches or gonads which are produced in the course of the radiating canals, not as true buds, but as simple extensions of the canal walls, caused by the presence of the sexual products between their endoderm and ectoderm; and I would accordingly view this second form of planoblast as also giving rise to its sexual elements directly, and therefore, like the first, as the exact locomotive equivalent of the hedrioblast or sedentary gonophore.

3. *Development of the Ovum.*

In by far the greater number of species the development of the ovum results in the formation of a ciliated locomotive larva known as a *planula*. In such cases the ovum, which is mostly destitute of vitellary membrane, after passing through a regular or nearly regular segmentation in accordance with the usual binary law of embryonal development, becomes transformed into a solid spherical mass of cells (blastosphere) from which a peripheral layer soon becomes separated by a process of delamination. The embryo now as a rule becomes more or less elongated, and a central cavity makes its appearance in it.

At this stage the embryo is in the form of a hollow oviform body whose walls are composed of two layers, an external or ectoderm, and an internal or endoderm. It is by delamination, never by invagination, that the two germinal layers, ectoderm and endoderm, are formed. The embryo has now usually escaped from the confinement of the gonophore, and its ectoderm becomes clothed with vibratile cilia, by the aid of which

wish for an opportunity of examining other examples which might supplement the very scanty material at the disposal of Goette.

In some common Hydroids no gonosome has yet been found. Until, however, we know the time of year and other conditions which may be here necessary for the development of the gonosome, an ignorance of this element in certain Hydroids affords no grounds for regarding its absence in these as a constant and permanent occurrence.

it moves about as a free larva in the surrounding water. It would seem to be about this time that the mesosarc shows itself as a very fine structureless membrane between the endoderm and ectoderm. To the larva thus formed, Dalyell, by whose observations it was first made known, has given the name of "planula."[1] The planula is still a completely closed sac. After enjoying for a time its free locomotive life it loses its cilia and fixes itself by one end—the aboral pole. A delicate chitinous pellicle, the foundation of the perisarc, is excreted over a greater or less extent of its surface; the free or oral pole becomes perforated by a mouth round which a circle of tentacles has become developed. The larva may now be recognised as the primordial hydranth of the colony, and it only remains for this to become complicated by the budding of other hydranths and of the sexual zooids in order that it may attain the condition of the fully developed dendritic colony.

The mode of formation of the planula now described is in its essential features that which has shown itself in all Gymnoblastic and Calyptoblastic Hydroids in which a planula has been noticed, and subjected to sufficiently careful observation, with the exception of *Eucope polystyla*, one of the Campanularians, in which Kowalevsky has described a somewhat different process.[2] According to this observer the ovum as the result of segmentation becomes converted into a blastosphere with a large central segmentation cavity, in the walls of which only a single layer is present. From the inner surface of the walls, cells are now budded off, and these fill the segmentation cavity with a solid cellular mass which represents the endoderm. The original single layer forms the ectoderm, and becomes clothed with cilia. In the endodermal mass a slit-like cavity—the primitive gastric cavity—now shows itself, and thus completes the formation of the planula stage of the larva.

We know as yet very little of the development of those Medusæ which pass to their adult state directly from the egg without the intervention of a polypoid trophosome (see above, p. xxix). The researches of Metchnikoff[3] have shown that in at least two of these, *Polyxenia leucostyla* and *Æginæta flavescens*, the segmentation of the ovum results in the formation of a solid morula, from which a peripheral layer is differentiated by delamination as an ectoderm, which becomes clothed with vibratile cilia. In the central or endodermal cell-mass of the body thus formed the primitive gastral cavity makes its appearance, and soon opens externally by the formation of a mouth. On two opposite points the body becomes extended into a solid tentacle, and two other similar tentacles subsequently make their appearance in a median plane at right angles to that of the former, so that the symmetry, at first bilateral, becomes radial. Between the ectoderm and endoderm a clear gelatinous layer is excreted, and this rapidly increasing in volume while the larva assumes a more lenticular form, becomes the gelatinous umbrella of the

[1] Sir J. Graham Dalyell, Rare and Remarkable Animals of Scotland, London, 1847.

[2] Observations on the Development of Cœlenterata, *Trans. Friends Nat. Hist., Anthrop. and Ethnog. Moscow*, 1873 (Russian).

[3] Studien über die Entwickelung der Medusen und Siphonophoren, *Zeitschr. f. wiss. Zool.*, Bd. xxxiv. p. 1074.

adult. By further changes in the relative lengths of the diameters, an increase in the number of tentacles, and the formation of marginal sense organs and of a velum, the larva assumes the form of the adult.

Metchnikoff[1] and Fol[2] have both, independently of one another, traced the development of the egg in *Geryonia hastata*, another member of the group which never passes through a polypoid trophosome, and have arrived at essentially similar results. In this Medusa the segmentation of the egg gives rise to a blastosphere with a large segmentation cavity, and with walls as yet formed by a single layer of cells. By the transverse division of these cells, the walls of the hollow blastosphere becomes differentiated into an ectodermal and an endodermal layer. Between these a clear homogeneous gelatinous excretion is deposited as the rudiment of a gelatinous umbrella, and by its unequal accumulation renders the segmentation cavity more and more excentric, until its endodermal lining again comes in contact at one point with the ectoderm. At this point a mouth is formed, and the segmentation cavity, now become the gastral cavity of the Medusa, is brought into connection with the exterior. Round the mouth the ectoderm forms a thickened ridge from which the rudiments of the tentacles shoot forth, and from which a perforated diaphragm extends towards the axis as a velum. In none of these cases, however, do the observers give any account of the formation of the gastrovascular canals, and a very important point in the development has thus been left unsolved.

The endoderm and ectoderm of the Hydroida represent, as was first pointed out by Huxley,[3] the inner and outer germinal layers, to the formation of which the early stages of the development of the ovum lead throughout the whole of the Metazoal members of the animal kingdom; but while these become in the higher Metazoa so transformed as to be no longer recognisable as definite layers, they remain as permanent elements in the structure not only of the Hydroida but of all the other members of the Cœlenterata, where they still continue as the endoderm and ectoderm of the adult.

The development of the Hydroid colony through the formation of a planula is characteristic of the great majority of the Hydroida. There are, however, three genera—*Tubularia*, *Myriothela*, and *Hydra*—in which the development of the egg has been proved not to result in the formation of a free planula, while one or two others may possibly come into the same category, though an opportunity of studying them sufficiently to render this point certain has not yet been afforded.

Development of the Egg in Tubularia.—In *Tubularia* and in *Myriothela* there is formed instead of a planula a locomotive actiniform larva which is destitute of a ciliated epithelium and moves about by the aid of long tentacular processes. The development of the embryo in two species of *Tubularia* (*Tubularia indivisa* and *Tubularia larynx*) has been followed by myself, while Ciamician and Weismann have examined it in *Tubularia*

[1] Metchnikoff, *loc. cit.* [2] Fol, *Jenaische Zeitschr.*, Bd. vii.
[3] Huxley, On the Anatomy and Affinities of the Medusæ, *Phil. Trans.*, 1849.

mesembryanthemum. The researches of these last observers have shown that in *Tubularia mesembryanthemum* the sexual cells are derived from that part of the ectoderm which forms the deeper portion of the endocodon in the very young gonophore. It is this portion which ultimately becomes the ectodermal covering of the spadix, and the place of origin of the sexual cells thus coincides with their place of development, so that they do not here require as in other instances to wander from one to the other. Weismann and Ciamician agree in believing that the great majority of the egg-cells serve merely as food-cells, and after attaining a certain size become broken down and dissolved, thus affording nutriment for those egg-cells which are destined for development.—a view which, as we shall presently see, is supported by the phenomena observed in *Myriothela.*

In the very young gonophore—whether male or female—the sexual cells, as may be seen in *Tubularia larynx*,[1] already surround the spadix, and soon quite fill the cavity which is included between the spadix and its now widely separated ectodermal coat, and thus serves in the female as a brood chamber for the developing embryo. In the egg-cells which at this stage fill the brood chamber in *Tubularia larynx* may be seen a large nucleus with nucleolus (germinal vesicle and germinal spot).

With the growth of the gonophore the mass of sexual cells which it contains becomes more and more voluminous, and we soon find that the place of these egg-cells is taken by a plasma-like mass which envelops the spadix, and which still continues to increase in volume with the continued growth of the gonophore. We next see that a portion of the mass has become detached from the rest in order to undergo a special development within the cavity of the gonophore. Whether this detached mass can be regarded as a true ovum may be doubted, but at all events it takes the part of an ovum in passing through various stages of development. It is destitute of external membrane, and it is probable that it is at this stage that the influence of the male element is exerted on it, and that the process of segmentation takes place. This process, however, is here very obscure, and observations have failed in obtaining satisfactory results as to the mode in which it is carried on.

According to Ciamician the segmentation of the ovum in *Tubularia mesembryanthemum* is an irregular one, the embryo being formed by an epibolic extension of some of the segmentation spheres over the remainder, the former giving rise to the ectoderm, and the latter to the endoderm.

This form of segmentation, by which some of the segmentation spheres rapidly multiply and surround the others, closely resembles that of the Ctenophora, and is very different from what takes place in the formation of a planula. I have never seen anything of the kind in the species of *Tubularia* whose development I have studied, and neither Balfour[2] nor Kleinenberg have been able to confirm the conclusions of Ciamician.

[1] Gymnoblastic Hydroids, p. 91, pl. xxiii. figs. 19–24.

[2] Balfour's Works, Memorial Edition, vol. ii. p. 154.

The exact significance of the plasma-like mass which surrounds the spadix, as well as the portions which become detached from it, seems open to question. That they contain cell-like elements there can be no doubt, and as these show themselves before any apparent segmentation can be detected, they can scarcely be otherwise regarded than as the remains of the germ-cells, which from an early period filled the gonophore, and are now in process of coalescence with one another so as to form the plasma mass, while others have probably broken down, and served as nutriment for the developing embryo.

Ciamician, however, regards each plasma mass in *Tubularia mesembryanthemum* as an ordinary ovum, and compares the cell-like elements which exist in it to the "pseudo-cells" discovered by Kleinenberg in the ovum of *Hydra*. These cell-like elements are, however, very different in appearance from the hollow thick-walled corpuscles described as pseudo-cells by Kleinenberg, while the phenomena presented by the development of the embryo in *Myriothela* (see below, p. xli) are in favour of regarding the plasma masses of *Tubularia* as formed by the coalescence of the original germ-cells. In whatever light we view them, the further course of development in *Tubularia indivisa* and *Tubularia larynx* is as follows:[1]—

The portion which in the way just mentioned has been detached from the general mass, continues to lie for some time in the cavity of the gonophore, where it becomes further developed into an actiniform larva. During this development, it first acquires a flattened, somewhat disc-shaped form, and in such shape becomes extended over the remaining portion of the sexual mass by which the spadix continues to be surrounded. In the centre of the disc a cavity—the primitive digestive cavity—soon shows itself, while from the circumference short but thick outbulgings of this cavity radiate, and soon become elongated into tentacles. The disc at the same time becomes more gibbous on the side turned away from the spadix, while a mouth makes its appearance in the centre of the opposite side. The embryo now retreats from the residual generative mass, the mouth is seen to be elevated on a conical prominence (hypostome), while the side opposite to the mouth becomes prolonged into the commencement of a stem-like extension which has the digestive cavity of the embryo continued into it. In this state it escapes from the gonosome, a second circle of very short tentacles having in some species (*Tubularia indivisa*) become first developed round the mouth, while in others (*Tubularia larynx*) the oral tentacles do not make their appearance until after the escape of the embryo. The embryo continues free for a period, during which it creeps about by the aid of its circlet of long proximal tentacles, which are now thrown back round the aboral pole. In the meantime the aboral pole has become further elongated into a cylindrical stem which soon clothes itself with a perisarc and fixes the young *Tubularia* to some neighbouring object.

After the escape of the embryo, or even during its development within the gonophore,

[1] Gymnoblastic Hydroids, p. 90, pl. xxiii. figs. 11–16 and 19–24.

the remains of the generative mass may still throw off portions giving rise to embryos which become developed in a similar way into free actiniform larvæ. To such larvæ the name of *Actinula* may be given in order to distinguish them from the planula of other Hydroids.

Development of the Egg in Myriothela.—In the development of the egg in *Myriothela* we meet with some remarkable departures from the phenomena usually presented in the embryonic development of the Hydroida.[1]

The eggs of *Myriothela* have their origin in the cells of the endodermal layer which forms the walls of the spadix. Certain cells of this layer in the very young gonophore become transformed into egg-cells which increase in number and in size until the cavity of the gonophore is entirely filled with them. Each egg-cell has now its well-defined germinal vesicle and germinal spot, and its vitelline protoplasm, but without any apparent vitelline membrane.

The egg-cells continue to increase in size with the growth of the gonophore, they remain for some time closely pressed one against the other so as to acquire a polyhedral form, but they gradually become looser, assume an oviform shape, and may now be easily isolated by the needle or by the mere action of the compressorium. Their germinal vesicle is now very large and distinct, and within the large germinal spot a well-defined nucleolus may be detected.

The egg-cells have no sooner thus attained their complete separation from one another, and have acquired their full size in the gonophore, than they begin to present a very remarkable phenomenon. They lose their independent existence, and begin to undergo a fusion into one another; and when the contents of the gonophore are now liberated by rupture of its walls under the microscope, many of these nucleated protoplasm masses may be seen to be united to one another by irregular pseudopodia-like extensions of their substance. By the gradual shortening and thickening of these processes the little masses which they connect are drawn closer to one another, and end by becoming completely fused together into a common protoplasmic mass. In this mass the cell boundaries are completely lost, but numerous nucleolated nuclei may be seen scattered through its substance. These are almost certainly the nuclei with their included nucleoli of the originally independent egg-cells.

Several such masses, eight or more, will thus be formed within the gonophore, from the coalesced ova. They are of an ovoid form, and do not entirely fill the cavity of the gonophore, while the narrow intervals between them, as well as the small space which separates them from the walls of the gonophore, are occupied by a substance which appears to consist chiefly of free nuclei and of dwindled and degraded ova, all apparently undergoing a process of liquefaction, and doubtless an unused residuum of the bodies, by the coalescence of which the compound masses had been formed.

[1] See Memoir on the Structure and Development of Myriothela, *Phil. Trans.*, vol. clxv. pt. 2, 1875.

If in this stage the gonophore be laid open, and the protoplasm masses, whose formation we have been tracing, be liberated under the microscope, we shall often succeed in witnessing very minute processes of clear protoplasm, which have become developed over the surface. These, however, are not permanent structures, and they will often, while the object continues under observation, become entirely withdrawn. They are in fact true pseudopodia, and are probably employed in the nutrition of the masses from which they arise.

The contents of the gonophore, however, are destined to undergo further change before the period of their liberation has arrived. The separate protoplasm masses increase in size, the residual matter which had surrounded them has disappeared, having probably afforded material for their nutrition, they begin to coalesce with one another, and there is ultimately formed a single large *plasmodium* which entirely fills the cavity of the gonophore. When this plasmodium is examined under the compressorium, the same nuclei which had hitherto characterised the products of the coalescence of the ova are seen to be scattered in great number through its substance. These nuclei, however, have already begun to suffer a change, for while in some the nucleolus is still distinct, in others it has quite disappeared, and while in some the contents consist of a minutely granular matter, in others they are quite homogeneous.

When the separate protoplasm masses have all united with one another, or a little before they have become so completely fused together as to have their original distinctness entirely lost, the time has arrived when the contents of the gonophore are to be expelled. Its walls, which present the remarkable character of having a strong muscular layer developed in them, now begin to contract on the contained plasmodium, which is thus gradually forced out through the summit of the gonophore. By the continued contraction of the walls of the gonophore, the plasmodium is at last entirely expelled, completely enveloped, however, in a transparent structureless membrane. The empty gonophore may now be seen retracted in the form of a shallow thick-walled cup with everted edges, upon the summit of its short peduncle.

The liberated plasmodium closely enveloped in its structureless capsule is of a nearly spherical form, and now lies upon the retracted gonophore. It does not, however, continue long in this position, for the function of the claspers is soon brought into play. These remarkable bodies, which have no representative in any other known Hydroid, are long, cylindrical, very contractile, tentacle-like organs which spring from the body of the hydranth. Each is slightly enlarged towards its distal extremity where it terminates in a sucker-like disc. One of these claspers (sometimes two or even three) now stretches itelf out towards the liberated plasmodium, and as soon as it reaches it, it becomes attached by its sucker-like extremity to the capsule and then by strong contractions pulls the plasmodium still enveloped in its capsule away from the remains of the gonophore on which it had lain.

By this time the coalescence of the separate plasma masses into a single spherical plasmodium has been completed ; but soon after the liberation of the plasmodium and its seizure by the claspers, we find that the whole has become broken up into a multitude of small round or irregularly shaped masses. These all consist of a granular protoplasmic matter without any distinct boundary membrane, and with numerous nucleus-like bodies immersed in their substance. The common external structureless membrane is distinct, but it is still thin and weak.

Notwithstanding the apparent absence of anything like a definite law of cleavage, it is impossible to avoid comparing this breaking up of the plasmodium with the segmentation of the ovum, and hitherto we have seen nothing which in any way resembles this phenomenon. We must, however, be careful not to push this comparison beyond its legitimate limits, for we are not here dealing with an ovum in the ordinary sense, but with a multitude of egg-cells coalesced into a single *syncytium*.

But subsequent stages no less than that just described recall the phenomena which present themselves in the development of the typical ovum into the planula of other Hydroids. The segmented condition of the plasmodium disappears, and its substance is once more found in the state of an undifferentiated plasma.

Soon, however, a definite histological differentiation begins to show itself. This results in the formation of a single spherical body, within which, probably by a process of liquefaction, a large central cavity has made its appearance. At the same time, the walls of the cavity are seen to possess a distinctly cellular structure, and to have become split, apparently by delamination, into two concentric laminæ, the first indication of the ectoderm and the endoderm.

This is the foundation of the Actinula. The Actinula of *Myriothela*, however, differs from that of *Tubularia* in the possession of long transitory arms which serve for locomotion. These originate in involutions of the walls of the hollow sphere. By this process, which seems to be without parallel among the Hydroida, the transitory arms of the Actinula show themselves first as hollow cæcal projections into the cavity of the sphere. An evagination, however, of these projections soon takes place, so that by their eversion they come to occupy the position of external appendages.

Up to this period the embryo had retained its nearly spherical form, but it now begins to elongate itself and assume an ovoid shape. Then one pole becomes truncated, and a mouth here makes its appearance, while the permanent tentacles begin to shoot out around it in the form of short papilliform processes.

The Actinula is now ready to escape from its enclosing capsule, which since the seizure of the germ by the clasper had all along remained adherent to the extremity of this organ. The capsule now becomes ruptured and allows the larva to enter on a free life in the surrounding water.

The transitory arms like the permanent tentacles are hollow. They terminate each in a well-defined capitulum and are about twenty in number. They form no regular verticil but extend with a scattered disposition over the greater part of the body, Upon the escape of the Actinula they continue to increase in length, and have the faculty of holding on by their clavate extremities to neighbouring surfaces. It is thus by their aid that the larva creeps about on the various objects in its vicinity.

After the Actinula has enjoyed for some days its free locomotive existence, it begins to fix itself by its aboral sucker-like extremity; the permanent tentacles become more numerous and extend further backwards on the body, while the long arms undergo a rapid degradation, become much shortened, and soon entirely disappear. All the essential features of the adult trophosome are thus acquired, and it only remains to complete the development of the Hydroid by the formation of the gonosome, which soon makes its appearance by the budding of the blastostyles and claspers from the hydranth at the proximal side of the tentacles. From the blastostyles the gonophores are subequally budded off, and the animal thus attains its complete maturity.

Myriothela phrygia, the only known species of this remarkable genus, is monœcious, the same hydranth carrying both male and female gonophores, but at what part of the developmental process just described the male influence exerts itself, or what may be the immediate changes which result from this, are points on which the observed facts will not justify a definite conclusion.

It will be seen that the formation of the Actinula in *Myriothela* is connected with certain phenomena which are very remarkable and exceptional. Among the most significant of these is the formation of a plasmodium by the coalescence of numerous primitive egg-cells. Exceptional, however, as this phenomenon is, it is not without a parallel even among the higher animals, and will at once recall the formation of the permanent ovum, as a syncytium, from the coalescence of the "primitive ova" in the early stages of the ovary in certain Elasmobranch fishes.[1]

Development of the Egg in Hydra.—The phenomena presented during the development of *Hydra* are in many respects scarcely less divergent from the ordinary course of Hydroid development than those just described in *Myriothela*.

It is to the researches of Kleinenberg that we are indebted for the first complete account of the development of the sexual structures in *Hydra*.[2] He has shown that both ovaria and testes are derived from certain cells of the ectoderm which lie between

[1] See Balfour's Works, Memorial Edit., vol. i. p. 587; vol. ii. p. 57. Korotneff, who seems to be the only other observer who has studied the structure and development of *Myriothela* (*Zool. Anzeig.*, Bd. i. p. 363, 1878; Bd. ii. p. 187, 1879) takes a different view of the whole process. He supposes that among the multitude of egg-cells which originally fill the cavity of the gonophore, only one becomes a true egg, and that from this alone the Actinula is developed. I cannot, however, accept this view. It is impossible to reconcile it with the facts just described, and a laborious investigation of the animal has, I believe, placed the truth of these facts beyond question.

[2] Nicolaus Kleinenberg, Hydra, eine anatomisch-entwicklungsgeschichtliche Untersuchung, Leipzig, 1872.

the deeper parts of the epithelial muscle-cells, where they form a tissue to which he has given the name of "interstitial tissue."

In a circumscribed portion of this tissue which is to become the testis, a more vigorous growth takes place. The cells composing it enlarge and multiply by division, and form a many-layered, compact, lenticular body. This is the testis; it forms a projection from the body of the *Hydra*, covered by the epithelial muscle-cells.

In the meantime the nucleus of the testicular cells becomes replaced by one or more sharply contoured, strongly refringent corpuscles. The cell is now a perfectly transparent sphere. On one spot of the surface there arises a fine plasma process with active flagellate movements. This is subsequently seen to have become united with one of the corpuscles in the interior of the cell, and by its action the corpuscle to which it had attached itself is finally drawn out from the generating cell, and the mature spermatozoon is thus set free.

The foundation of the ovary agrees essentially with that of the testis. The cells of the interstitial tissue in a zone which in *Hydra viridis* embraces nearly half the circumference of the body multiply and unite with one another into groups, composed each of a single layer of cells. These cells increase in size, and the groups themselves finally unite into a one-layered flattened cell-mass in which a multiplication of cells still goes on.

This cell-mass forms the ovarium, and when it has reached the stage here described a single cell which usually lies exactly in its middle begins to be distinguished by more active growth from the others. This is the young egg. It continues to increase in size, while its surface becomes extended into processes which with the continued growth of the egg pass into broad irregular lobes.

With further growth the egg becomes extended in width without increasing in thickness, and two incisions now show themselves opposite to one another on the edges of the somewhat disc-shaped egg, and extending deep into the interior, cut the egg into two lateral halves connected by a narrow middle isthmus, and having their edges irregularly notched and cleft. The egg continues to increase in width, and the form which it now presents has been compared by Kleinenberg to that of a butterfly with expanded wings, the edges of which are irregularly notched and torn. In the connecting isthmus lies the germinal vesicle with its included nucleolus or germinal spot.

Besides irregularly-shaped granules of apparently albuminous nature chlorophyll grains now show themselves in *Hydra viridis* embedded in the plasma of the egg.

The outgrowths from the plasma increase in size and now form the principal part of the egg. They branch dichotomously, push themselves between the other cells of the ovary, and the egg becomes eminently amœbiform.

At the same time there appear in the plasma sharply contoured corpuscles. These are usually in the form of thick-walled hollow spheres, and in *Hydra viridis* there

may be seen in them a conical projection attached by its base to a point on the inner surface of the wall, whence it extends deep into the interior.

These bodies are certainly not cells; they take no direct participation in the development of the embryo, and Kleinenberg, who has traced them from small globular condensations of the plasma, assigns to them the name of "pseudo-cells." They seem to have the significance of reserve matter, and gradually disappear.

The egg still continues to increase in size, but the outrunning extensions of its plasma are gradually withdrawn, and the egg loses its amœboid form, and becomes rounded into a broad ovoid.

About the time when the formation of pseudo-cells has ceased the germinal vesicle and germinal spot begin to undergo a disintegration, and finally disappear long before the commencement of fecundation. The remaining cells of the ovary also become disintegrated and are manifestly used up as nutriment for the ovum.

By the pressure of the subjacent egg the ectoderm which lies over it becomes protruded in the form of a sac, in the summit of which a narrow orifice makes its appearance. Through this the egg is forced out into the surrounding water, though it still continues for some time to hang to the parent *Hydra* by a small part of its surface. It is now that the naked egg is exposed to the influence of the spermatozoa diffused through the water, and becomes fecundated.

The segmentation which now begins in the ovum is in accordance with the common law of binary cleavage, except that when the cleavage advances to a certain stage it loses somewhat of its regularity, some of the segmentation spheres cleaving less rapidly than the others. During this process pseudopodia are developed from the surfaces of cleavage, but these at a later period disappear. When the number of the segmentation spheres has reached thirty-two the surface of the egg has the mammillated condition of the mulberry form. Later on this disappears and the egg becomes quite smooth.

When the segmentation has been completed two kinds of cells may be distinguished in the germ. One of these consists of elongated prismatic cells resembling those of a cylinder epithelium. They form a one-layered stratum on the surface of the germ. The other consists of shorter cells rendered polygonal by mutual pressure. These form the main mass of the germ. All these cells are naked plasma masses, at first destitute of nucleus, but at the end of some hours nuclei make their appearance in the superficial cells, and soon after in the deeper ones. It seems certain that these nuclei arise independently in cells previously destitute of them.

Soon after these occurrences it is seen that the albuminous corpuscles, chlorophyll grains, and pseudo-cells contained in the superficial prismatic cells have retreated into the deeper parts of these cells, while the nucleus remains for some time immediately beneath their free surface, but ultimately disappears.

After these changes in the prismatic cells a continuous membrane can be seen extending over the entire surface of the germ. By maceration it can be separated from the subjacent plasma, and by its resistance to the action of chemical reagents it appears to be of a chitinous nature. The first formed membrane increases in thickness by the formation below it of many successive layers, and the germ instead of being surrounded by a layer of naked prismatic cells has become enclosed in a thick chitinous shell.

After this outer shell has been completed there is formed between it and the germ a second envelope. This is a thin, structureless, transparent, and very elastic pellicle. It is probably formed by the hardening of an excreted liquid.

Kleinenberg regards the outer shell as formed by a total transformation of the entire outer cell stratum. The shell is accordingly an epidermal structure, and the first differentiation of the germ of *Hydra* thus consists in the formation of a peripheral one-layered cellular lamina, the component cells of which die, and have their plasma transformed into chitin so as to form a firm shell which protects the remaining part of the germ from destruction during the long period of its subsequent development. The first organ which proceeds from the *Hydra* germ is thus a transitory one which takes no direct part in the development, and which on the liberation of the definitive body is simply cast off.

As soon as the shell is completed the union of the germ with the maternal body is dissolved, and the germ falls off and sinks to the bottom. A remarkable change now takes place in the structure of the germ. This consists in the fusion of all its cells into an undifferentiated plasmodium. All trace of a cellular structure disappears, and the germ becomes again, like the unsegmented egg, a single large plasma mass, thickly filled with albumen granules, pseudo-cells, and chlorophyll grains.

In this uniform mass there is now formed a small cavity which lies excentrically near the surface. This is the foundation of the body cavity. It enlarges in all directions, and it is clear that it arises by a true liquefaction of a great part of the substance of the germ. The walls, however, of the hollow germ thus formed are as yet uniform and show no trace of differentiation.

In this state the germ remains for many weeks, during which the outer shell becomes softer, and is finally burst and cast off. The germ, however, which it had enclosed continues to be overlaid by the elastic transparent inner shell which lies close upon its surface.

In the hitherto uniform walls of the germ we may now distinguish two layers. This condition is caused by the retreat of the pseudo-cells from the more superficial parts of the wall into its deeper parts, resulting in the appearance of an external clear layer and an internal darker one. This is the first indication of the differentiation of the two germinal layers. Out of the clear layer the ectoderm is formed, out of the darker one the endoderm. By a further differentiation these layers become changed from a continuous plasma into cellular laminæ.

The embryo now extends itself and assumes an ellipsoidal form. On one pole the walls grow thinner and soon present a stellate cleft which becomes the mouth. Simultaneously with the formation of the mouth the tentacles show themselves as short, blunt, conical outbulgings of the body walls.

The embryo commonly remains two or three days within the covering of the inner shell. This, however, gradually softens and becomes changed into a tenacious adhesive mucus, which is finally dissolved in the water, and the animal becomes free with all the essential characters of the adult.

It will be thus seen that in *Hydra* no gonophore is formed as an independent zooid, and that the generative elements not only originate in the walls of the body but are retained there up to the period of their liberation in the surrounding water. It will also be apparent that in *Hydra* development takes place without the post-embryonic period of its life presenting anything like a true metamorphosis, and that there is here nothing which can be regarded as a proper larva stage. In this respect *Tubularia* agrees most nearly with *Hydra*, but here the Actinula is a true larva differing from the adult not only in its free mode of life but in its form, though it has no obvious organs which are not also present in a more or less modified shape in the adult. *Myriothela* differs still further in having a more distinctly pronounced larval stage, and in undergoing a well-marked metamorphosis, the Actinula of *Myriothela* being provided in a very characteristic way with transitory organs which entirely disappear during the further course of the development.

PRIMARY MODIFICATIONS OF FORM.—CLASSIFICATION OF THE HYDROIDA.

A complete system of the Hydroida would include not only all Hydroid trophosomes with their associated gonosomes, but all Hydromedusæ, whether traced to polypoid trophosomes or not. There exist, however, many free Hydromedusæ—both Anthomedusæ and Leptomedusæ,—which have not yet been so traced; but so closely do these correspond with Medusæ, which are known to be budded off from fixed trophosomes, that there can scarcely be a doubt that, were we acquainted with their whole life-history, we should find that, like the Medusæ which have been traced to hydriform stocks, these also are planoblasts which had originated as buds from fixed trophosomes. As, however, nothing is known of the trophosomes from which these Medusæ have been derived, it has been generally deemed convenient to treat them independently as members of a general system of the Medusæ, in which the Medusal structure is made the basis of the classification, without necessary reference to the morphological details of the polypoid trophosomes.[1]

There is, however, another group of Craspedotæ or Hydromedusæ, into whose life series a polypoid term does not appear to have been ever intercalated, and which may accordingly be regarded as forming in themselves a separate and well-defined group of the Hydroida.

It is proposed, therefore, in the following sketch of Hydroid classification, to include in the first place those Hydroids with whose trophosomes we are acquainted, making the characters of the trophosome the primary element in the classification; and in the second place, such free Hydromedusæ as there is good reason to believe are never derived from polypoid trophosomes. In the meantime, such free Anthomedusæ and Leptomedusæ as have not yet been traced to their trophosomes must be left to find their proper places among the former group as soon as the discovery of their trophosomes shall afford the necessary data.

The order Hydroida, in the sense in which it is thus proposed to regard it, includes so many well-marked modifications of form, that the zoologist has no difficulty in finding among these such characters as may be legitimately used as the bases of natural systematic groups.

A comparison of the members of the Hydroida with one another shows that—including the extinct Graptolites, whose allocation, however, among the Hydroida, depends on considerations of a more or less hypothetical nature—the order embraces within itself six primary types of form.

[1] See especially Haeckel, Das System der Medusen, Jena, 1879.

In one of these, neither hydrothecæ nor gonangia are developed, so that both hydranths and gonophores are always naked, or if a perisarcal pellicle is excreted over the body of the hydranth, as in *Eudendrium vestitum* (Pl. I. fig. 1), or over the gonophore as in *Cordylophora lacustris*, it is in the former case an adherent coat from which the hydranth is never free as in a true hydrotheca, and in the latter case, it is similarly adherent to the outer surface of the gonophore, and totally different from a gonangium which always includes a blastostyle, from which one or more gonophores are budded off. The gonophores are in some cases hedrioblasts, in others planoblasts, and the planoblasts, with scarcely an exception, belong to the Anthomedusal section of Craspedote Medusæ, and have the generative elements developed in the walls of the manubrium.

To this type the designation of GYMNOBLASTEA has been given.

In another type of Hydroid form the hydranths are protected by hydrothecæ and the gonophores by gonangia; and though in one family (Haleciidæ) the hydrothecæ may be so degraded as to afford scarcely any protection to the hydranth, they are still recognisable under this degraded form. In this type, as in the former, we meet with both hedrioblastic and planoblastic gonophores, and when these are in the form of planoblasts, they belong almost without an exception to the Leptomedusal section of the Craspedote Medusæ, and have their generative elements developed along the course of the radial canals.

The group thus characterised forms the suborder CALYPTOBLASTEA.

Both the Gymnoblastea and the Calyptoblastea, when new hydranth buds are emitted by them, retain these as permanent elements of the colony. There is, however, another small group of Hydroids in which the hydranth buds, after attaining a certain degree of maturity, detach themselves and lead henceforth, like the parent animal, an independent and free life. This group is represented by the fresh-water *Hydra*. No perisarc is here excreted, and the generative elements are not contained in gonophores, but are developed directly in the deeper parts of the ectoderm of the hydranth.

The group thus characterised forms another suborder—that of the ELEUTHEROBLASTEA.

In a fourth group we have again hydranths united into permanent colonies, but the skeletal structures which when present in the former groups are in the condition of a chitinous perisarc, are here represented by a hard calcareous corallum. This is permeated by a network of inosculating cœnosarcal canals, and is overlaid by an external ectodermal coat. From the cœnosarcal network are developed zooids of two kinds; one (gastrozooids) with a mouth and stomach, and with a circlet of tentacles; the other (dactylozooids) in the form of tentacula-like zooids, and destitute of mouth. The gastrozooids represent the hydranths of the preceding groups. Both kinds of zooids are lodged within chambers excavated in the corallum and lined by reflections of the superficial ectodermal layer.

Our knowledge of the generative system is imperfect; but in one family at least the sexual elements appear to be developed in gonophores lodged in cavities of the corallum.[1]

The Hydroids constructed on the plan thus characterised constitute the fourth suborder, that of the HYDROCORALLIA.

As already said there are certain free Medusæ (Trachomedusæ and Narcomedusæ) which though they belong to the Craspedotæ are known to be developed directly from the egg without passing through a polypoid stage. Such a phenomenon, showing as it does the omission of a characteristic morphological element in the life-history of the species, renders necessary the association of these directly developed Medusæ into an independent group, which will thus form a fifth suborder of the Hydroida.

To this suborder the name of MONOPSEA has been given. It is exactly equivalent to the Trachylinæ in the system of Haeckel.[2]

If the view which I have elsewhere maintained[3] be correct, that the extinct organisms known as Graptolites were Hydroids in which a longitudinal chitinous rod had become developed in the walls of the cœnosarc, and in which the hydranths had been replaced by sarcostyles, which as we know precede the hydranths in the development of certain Plumularidæ, in whose early stages sarcostyles alone are present, then the Graptolites would represent another primary modification of Hydroid structure. I have accordingly, under the name of RHABDOPHORA, considered the Graptolites as representing one of the primary groups of the Hydroida. Having regard, however, to our necessarily very imperfect knowledge of these Palæozoic fossils, I do not desire to assign to this group more than a hypothetical value.

[1] See Moseley, *Phil. Trans.*, vol. clxvii., 1877; and Report on certain Hydroid, Alcyonarian, and Madreporarian Corals, Zool. Chall. Exp., part vii.

[2] In *Limnocodium*, whose relations to the Trachomedusæ are in many respects so close as to justify us in regarding it as an aberrant member of this group, there is some reason for supposing that a Hydroid trophosome shows itself in the course of its development. In the tank where this remarkable Medusa first made its appearance a minute Cœlenterate organism, comparable to a fixed Hydroid destitute of tentacles and otherwise in a condition of extreme simplification, was discovered by Mr. A. G. Bourne, and regarded by him as the hydriform trophosome of *Limnocodium*. It is difficult on any other grounds to explain the association of the two organisms in the same tank; but as no genetic connection between them has as yet been discovered, this must for the present be regarded as hypothetical; see A. G. Bourne in *Proc. Roy. Soc.*, 1884, vol. xxxviii. p. 9. A solitary exception to the generally admitted derivation of the Anthomedusæ and Leptomedusæ from polypoid trophosomes has been recorded by Claparede (*Zeitschr. f. wiss. Zool.*, 1861) who believes that he had seen the eggs of an Anthomedusa, referable to the type to which Edward Forbes gave the name of *Lizzia*, directly developed into Medusæ while still lying in the walls of the manubrium of the parent. It is, however, by no means rare for Medusæ to give rise by budding to young Medusæ in a way very similar to that in which planoblasts are budded off from trophosomes; such a formation of Medusa buds is well known to occur in the manubrium of *Lizzia*, and so very easy is it to confound the development of these buds in the Medusæ with that of an egg, that even so excellent an observer as Claparede may well have been deceived by it. But even though Claparede's view of the direct development of the egg in *Lizzia* be correct, this solitary fact need not be regarded as constituting a disturbing element in the classification here adopted.

[3] Gymnoblastic Hydroids, p. 279.

TABULAR VIEW OF THE LEADING SYSTEMATIC GROUPS OF THE ORDER HYDROIDA.

SUBORDER.	LEGION.		FAMILY.	EXAMPLES OF GENERA.
I. GYMNOBLASTEA. No hydrothecæ or gonangia. Nutritive zooids when more than one forming permanent colonies. Planoblasts in the form of Anthomedusæ.	TUBULARINÆ,	Trophosome consisting of a colony of organically associated hydranths and with a perisarc destitute of an external layer of cœnosarc.	Clavidæ,	*Clava, Rhizogeton, Cordylophora, Tubiclava, Merona,* &c.
			Corynidæ,	*Coryne, Syncoryne, Gymnocoryne, Gemmaria.*
			Bougainvillidæ,	*Bougainvillia, Perigonimus, Bimeria, Dicoryne, Stylactis,* &c.
			Eudendridæ,	*Eudendrium.*
			Pennaridæ,	*Pennaria, Stauridium, Cladonema,* &c.
			Cladocorynidæ,	*Cladocoryne.*
			Clavatellidæ,	*Clavatella.*
			Tubularidæ,	*Tubularia, Hybocodon, Ectopleura, Nemopsis.*
			Myriothelidæ,	*Myriothela.*
	HYDRACTININÆ,	Trophosome consisting of a colony of organically associated hydranths and with a perisarc which is overlaid by a superficial covering of cœnosarc.	Hydractinidæ,	*Hydractinia.*
			Podocorynidæ,	*Podocoryne, Corynopsis.*
	CORYMORPHINÆ,	Trophosome consisting of a solitary hydranth, perisarc evanescent.	Corymorphidæ,	*Corymorpha, Halatractis, Amalthea.*
			Monocaulidæ,	*Monocaulus.*
	HYDROLARINÆ,	Hydranths unsymmetrical, with the tentacles one or two in number springing from one side only of the body.	Hydrolaridæ,	*Lar.*
			Monobrachidæ,	*Monobrachium.*
II. CALYPTOBLASTEA. Hydranths protected by hydrothecæ. Sexual buds protected by gonangia. Nutritive zooids forming permanent colonies. Planoblasts in the form of Leptomedusæ.	CAMPANULARINÆ,	Hydrothecæ in at least the proximal part of the colony never adnate by their sides to the hydrocaulus.	Campanularidæ,	*Campanularia, Obelia, Thyroscyphus, Hypanthea, Calycella,* &c.
			Perisiphonidæ,	*Perisiphonia, Cryptolaria, Lafoëa, Lictorella.*
			Haleciidæ,	*Halecium, Diplocyathus, Ophioides.*
	SERTULARINÆ,	Hydrothecæ developed from more than one side of the hydrocaulus, to which they are all adnate for a greater or less extent by their sides.	Sertularidæ,	*Sertularia, Diphasia, Thuiaria, Desmoscyphus,* &c.
			Grammaridæ,	*Grammaria.*
			Synthecidæ,	*Synthecium, Thecocladium.*
	PLUMULARINÆ,	Hydrothecæ developed from one side only of the hydrocaulus to which they are adnate by their sides.	Plumularidæ,	*Plumularia, Antennularia, Acanthella, Schizotricha,* &c.
			Calicarpidæ,	*Calicarpa, Hippurella.*
			Aglaophenidæ,	*Aglaophenia, Acanthocladium, Cladocarpus,* &c.
			Halicornaridæ,	*Halicornaria, Azygoplon.*
	THALAMOPHORA,	Hydrothecæ adnate by their sides to the hydrocaulus. Cœnosarcal cavity divided by transverse septa into intercommunicating chambers.	Idiidæ,	*Idia.*

III. ELEUTHEROBLASTEA. No hydrothecæ or gonangia. Nutritive zooids not forming permanent colonies. No differentiated gonophores.	HYDRINÆ,	Hydrosome represented by a free hydranth. No perisarc.	Hydridæ,	*Hydra.*
			Protohydridæ,	*Protohydra.*
IV. HYDROCORALLIA. A skeleton formed by a calcareous corallum (cœnosteum) permeated by a system of ramified and inosculating cœnosarcal tubes from which the hydranths (gasterozooids) are developed	MILLEPORINÆ,	Hydranths lodged in receptacles of the corallum which are divided by transverse septa into a series of superimposed chambers.	Milleporidæ,	*Millepora.*
	STYLASTERINÆ,	Hydranths lodged in receptacles of the corallum which are destitute of transverse septa.	Stylasteridæ,	*Sporadopora, Stylaster, Distichopora,* &c.
V. MONOPSEA. Free Hydromedusæ which are developed directly from the egg without the intervention of a polypoid trophosome. Carrying on the umbrella margin auditory clubs with endodermal otolites.	TRACHOMEDUSÆ,	Gonads in the course of the radial canals.	Petasidæ,	*Petasus, Aglauropsis, Olindias,* &c.
			Trachynemidæ,	*Trachynema, Rhopalonema, Pectis,* &c.
			Aglauridæ,	*Aglaura, Aglantha, Persa,* &c.
			Geryonidæ,	*Liriope, Glossocodon, Geryonia,* &c.
	NARCOMEDUSÆ,	Gonads in the walls of the stomach.	Cunanthidæ,	*Cunantha, Cunoctona, Cunina,* &c.
			Peganthidæ,	*Polyxenia, Pegasia, Pegantha,* &c.
			Æginidæ,	*Ægina, Æginopsis, Æginodorus,* &c.
			Solmaridæ,	*Solmissus, Solmundus, Solmaris,* &c.
VI. RHABDOPHORA. Hydranths replaced by sarcostyles. Hydrocaulus traversed by a chitinous longitudinal rod.	GRAPTOLOIDEA,	Hydrosome developed from a persistent basal segment (sicula). Cœnosarcal canals giving origin each to a single series of sarcostyles.	Monoprionidæ,	*Monograptus, Rastritas, Didymograptus,* &c.
			Diprionidæ,	*Diplograptus, Climacograptus,* &c.
	RETIOLOIDEA,	Sicula not present. Cœnosarcal canal giving origin to two series of sarcostyles.	Glossograptidæ,	*Glossograptus, Lasiograptus,* &c.
			Gladiograptidæ,	*Retiolites, Trigonograptus,* &c.

DISTRIBUTION.

Though we are still without the data which would enable us to give a complete exposition of the distribution of the Hydroida, our knowledge of this has been very much extended by the explorations of the Challenger, and both in the horizontal distribution of these organisms, and in their bathymetrical range, important accessions have been made to it.

With the view of giving as graphic an expression as possible to the distribution of the species obtained during the voyage, I have divided the whole track of the Challenger into the following sixteen Regions, named either from the adjacent lands or from their position in the great oceans through which the course of the expedition lay. Their boundaries are detailed below and may be seen in the Map at the end of this Report. In order to render them as simple as possible, I have made the Regions to consist of rectangular areas, each limited to the north and south by parallels of latitude, and to the east and west by meridians of longitude. Their size varies much, and they are framed without regard to their occasionally encroaching on the adjacent continents.

Though the species are very unequally distributed among the various Regions, it was only from two of these Regions, the Britanno-Gallic whose Hydroid Fauna has been already well investigated, and the Antarctic, that no Hydroids were brought home.

I. Britanno-Gallic.

Limits—Northern, lat. 51° N.
Southern, lat. 45° N.
Eastern, long. 0°
Western, long. 20° W.

It includes the south-western extremity of England, and the north-western and western coasts of France.

II. The Azoric.

Limits—Northern, lat. 45° N.
Southern, lat. 35° N.
Eastern, long, 5° W.
Western, long. 50° W.

It includes the Azores, the western coast of Spain, and Gibraltar.

III. The Nova-Scotian.

Limits—Northern, lat. 50° N.
Southern, lat. 40° N.
Eastern, long. 50° W.
Western, long. 75° W.

It includes Nova Scotia and the neighbouring coast of North America.

IV. West Indian.

Limits—Northern, lat. 40° N.
Southern, lat. 10° N.
Eastern, long. 50° W.
Western, long. 80° W.

It includes Bermuda, the West Indian Islands, and the northern coast of South America.

V. Sargassic.

Limits—Northern, lat. 35° N.
Southern, lat. 0°.
Eastern, long. 10° W.
Western, long. 50° W.

It includes the greater part of the Sargasso Sea, Madeira and the Canary Islands, the Cape Verde Islands, Sierra Leone, and the adjacent coast of Africa.

VI. South Atlantic.

Limits—Northern, lat. 0°.
Southern, lat. 50° S.
Eastern, long. 10° E.
Western, long. 60° W.

It includes the eastern coast of South America, and the islands of Ascension and Tristan da Cunha.

VII. Cape of Good Hope.

Limits—Northern, lat. 30° S.
Southern, lat. 50° S.
Eastern, long. 40° E.
Western, long. 10° E.

It includes the Cape of Good Hope and Marion Island.

VIII. Kerguelen.

Limits—Northern, lat. 40° S.
Southern, lat. 60° S.
Eastern, long. 90° E.
Western, long. 40° E.

It includes Kerguelen Island and Heard Island.

IX. Antarctic.

Limits—Northern, lat. 60° S.
Southern, lat. 67° S.
Eastern, long. 100° E.
Western, long. 70° E.

No land is included in this Region. The most southern point attained by the track of the Challenger lies in it.

X. Australian.

Limits—Northern, lat. 20° S.
Southern, lat. 60° S.
Eastern, long. 170° W.
Western, long. 90° E.

It includes Southern Australia, New Zealand, Norfolk Island, Kermadec Islands, Tongatabu, and New Caledonia.

XI. East Indian.

Limits—Northern, lat. 30° N.
Southern, lat. 20° S.
Eastern, long. 170° W.
Western, long. 90° E.

It includes the northern coast of Australia, the Philippine and other islands of the East Indian Archipelago, the Solomon Islands, Caroline Islands, New Hebrides, and Fiji.

XII. Japanese.

Limits—Northern, lat. 50° N.
Southern, lat. 30° N.
Eastern, long. 160° E.
Western, long. 130° E.

It includes Japan and the adjacent coast of Northern Asia.

XIII. North Pacific.

Limits—Northern, lat. 50° N.
Southern, lat. 30° N.
Eastern, long. 120° W.
Western, long. 160° E.

It includes the southern extremity of Vancouver Island, and the Californian coast of North America.

XIV. Mid Pacific.

Limits—Northern, lat. 30° N.
Southern, lat. 20° S.
Eastern, long. 80° W.
Western, long. 170° W.

It includes the Sandwich Islands, the Marquesas Islands, the Low Archipelago, the western coast of Central America, the coasts of Peru.

XV. South Pacific.

Limits—Northern, lat. 20° S.
Southern, lat. 50° S.
Eastern, long. 70° W.
Western, long. 170° W.

It includes the island of Juan Fernandez, with the coast of Chili, and the greater part of the western coast of Patagonia.

XVI. Fuegian.

Limits—Northern, lat. 50° S.
Southern, lat. 60° S.
Eastern, long. 50° W.
Western, long. 80° W.

It includes the coasts of the southern extremity of Patagonia, Cape Horn, Terra del Fuego, and the Falkland Islands.

Among the species obtained are the following ten, which have been already recorded as inhabitants of the shores of Britain:—

Eudendrium rameum.
Halecium beanii.
Obelia geniculata.
Lafoëa dumosa.
Lafoëa fruticosa.
Sertularia polyzonias.
Sertularia operculata.
Sertularia abietina.
Diphasia pinaster.
Thuiaria cupressina.

Most of these are already known to be widely distributed along both the eastern and the western shores of the North Atlantic, while *Lafoëa fruticosa*, *Sertularia polyzonias*, and *Sertularia operculata* had been identified with species brought from various stations in the Southern Hemisphere. The explorations of the Challenger however have considerably extended our knowledge of the stations in which British species occur, and have shown, as will be seen from the annexed table of distribution, that most of those brought home have a much wider range than had been suspected. It is a fact not destitute of interest that no less than three of these British species, *Obelia geniculata*, *Lafoëa fruticosa*, and *Sertularia polyzonias*, have been brought by the Challenger from the Fuegian Region, and thus indicate a similarity of conditions between the northern and southern regions which shows itself in the appearance of the same species in both.

The Challenger dredgings have yielded two new species of the singular Campanularian genus, *Hypanthea*. One of these comes from the Kerguelen region, where a species of the same genus had already been discovered by the Transit of Venus Expedition. The other is from the Falkland Islands in the Fuegian Region. *Hypanthea* is a comparatively shallow water form, inhabiting a bathymetrical zone which corresponds pretty closely with the Laminarian zone of the British coast. The species from Kerguelen, *Hypanthea aggregata*, came from a depth of from 10 to 60 fathoms, and the Fuegian species, *Hypanthea hemispherica*, from a depth of 12 fathoms. No example of *Hypanthea* has as yet been found outside of these two Regions. In both it covered the fronds of a Laminaria-like seaweed and was associated with *Obelia geniculata*, thus pointing to an interesting parallelism between the Hydroid faunas of Kerguelen and the Falkland Islands, two Regions which, though separated by a wide distance in longitude, lie nearly in the same parallel of latitude.

Our knowledge of the remarkable Perisiphonic genus, *Cryptolaria*, has been enriched by the discovery of eight species, all of which are new. The maximum development of the genus as it appears in the Challenger collection is in the Australian and East Indian Regions, from which three species out of the eight have been obtained. These are *Cryptolaria abyssicola* from a depth of 2600 fathoms, *Cryptolaria geniculata* from a depth of 315 fathoms, and *Cryptolaria gracilis* from a depth of 700 fathoms. The remaining five are more sporadic in their distribution, being dispersed among five Regions, with one species in each, namely, *Cryptolaria humilis*, Azoric, with a depth of 1000 fathoms; *Cryptolaria flabellum*, West Indian, with a depth of 390 fathoms; *Cryptolaria diffusa*, Sargassic, with a depth of 2500 fathoms; *Cryptolaria crassicaulis*, Cape of Good Hope, with a depth of 420 fathoms; and *Cryptolaria pulchella*, North Pacific, with a depth of 20 to 40 fathoms.

The United States exploration of the Gulf Stream, however, has shown that there is a large development of the genus in the West Indian Region, four species having been dredged during that exploration in the Gulf of Mexico. As far as we know at present, therefore, there are two centres of maximum development for *Cryptolaria*, an eastern centre in the East Indian and Australian Seas, and a western centre in the seas around the West Indian Islands, a phenomenon which, as we shall presently see, is also apparent in the distribution of the Plumularinæ.

The bathymetrical range of the various species shows further that *Cryptolaria* is essentially a deep-water genus. Among all the species brought home by the Challenger, only one, *Cryptolaria pulchella*, has been obtained from a depth under 315 fathoms. This comparatively shallow-water species has been dredged from a depth of 20 to 40 fathoms in the North Pacific, while four have been obtained from the great depths of 700, 1000, 2500, and 2600 fathoms respectively. Among those, for the knowledge of which we are indebted to the United States expedition, three have been dredged from

depths of 450, 315, and 152 fathoms respectively, while the depth of one, owing to the effacement of the label, has not been recorded.

The genus *Perisiphonia*, also a deep-water form, gives us two species, both obtained in the Australian Region, where *Perisiphonia pectinata* occurred at a depth of 700 fathoms, and *Perisiphonia filicula* at a depth of 150. One of these, however, *Perisiphonia filicula*, was also found in the Azoric Region at a depth of 450 fathoms, and thus affords an instance of the same species occurring in two regions so widely separated as the Azores and Australia, without any intermediate station offering an example of it.

Grammaria, already known as a northern form, is represented in the Challenger collection by three new species, all from a comparatively narrow zone of southern latitude, *Grammaria insignis* having been obtained off Marion Island, near the southern boundary of the Cape of Good Hope Region, and from a depth of from 50 to 100 fathoms, *Grammaria stentor* from Kerguelen with a depth of from 28 to 60 fathoms, and *Grammaria magellanica* from the Fuegian Region, where it was trawled from a depth of 70 fathoms. All the three species thus occur at moderate depths, and their distribution is interesting as affording an example of stations, for the most part widely separated in longitude, and yet lying within a few degrees of the same parallel of latitude.

Sertularia, with the limits assigned to this genus in the present Report, has, as may be expected, yielded to the dredge and trawl of the Challenger a greater number of species than any other genus. Of these—seventeen in all—four have occurred in the Region of the Cape of Good Hope, four in the Kerguelen Region, and three in the Fuegian. Of the remaining species three have been found at the northern side of the equator, where the Azoric, Nova-Scotian, and West Indian Regions have each given one; while on the southern side the Australian, East Indian, and South Pacific Regions have also yielded one each. *Sertularia polyzonias* and *Sertularia filiformis* [*gracilis*], both from the Fuegian Region, are quite littoral, the former occurring at a depth of from 5 to 12 fathoms and the latter at a depth of 9 fathoms, while *Sertularia operculata*, an abundant and characteristic species of the British Laminarian zone, is shown to have a singularly wide area of distribution, having been brought up by the dredge of the Challenger from a depth of 45 fathoms off the western coast of Patagonia.

The genus *Diphasia* is represented in the collection by a single species, *Diphasia penaster*, which was dredged in the Azoric Region from a depth of 450 fathoms.

Thuiaria is represented by six species, two of which come from the seas lying to the north of the equator, and four from the seas lying to the south. They range from the Azoric to the Fuegian Regions, and include only one very deep dwelling species, namely, *Thuiaria hyalina* from the South Atlantic Region, where it inhabited a depth of 770 fathoms. *Thuiaria pharmacopola*, from the Azoric Region, was dredged from

a depth of 450 fathoms, while all the others are comparatively shallow water species, their stations varying from 9 to 70 fathoms in depth.

Desmoscyphus has yielded four species which, with the exception of *Desmoscyphus gracilis* from the West Indian Region, have all been found in the South Atlantic. Two of these, however, *Desmoscyphus pectinatus* and *Desmoscyphus obliquus*, afford an instance of unusually wide distribution, *Desmoscyphus pectinatus* having another station in the Australian Region, and *Desmoscyphus obliquus* also another in the East Indian.

Synthecium, hitherto known only as a New Zealand genus, has yielded to the dredge of the Challenger two new species obtained off the south-west coast of Australia.

Idia pristis, the only species as yet known of this remarkable genus, would seem to be widely distributed in the seas lying to the south of the equator. The Challenger obtained it from two stations, one in the South Atlantic Region and the other in the East Indian. In neither of these stations did the depth exceed 20 fathoms.

The Plumularinæ have yielded thirty-one species. As stated in the first part of this Report, it may be generally asserted of the Plumularinæ that they have their greatest development in the warmer seas of both hemispheres, and that in tropical and sub-tropical regions they attain their maximum in multiplicity of forms, in the size of the colonies, and in individual profusion.

Among the species of this group brought home few had been obtained from any considerable depth. *Cladocarpus*, however, which of all the genera of the Plumularinæ would seem to be that which inhabits the greatest depth, is represented in the collection by two species, *Cladocarpus pectiniferus*, which was dredged from a depth of 900 fathoms in the Azoric Region, and *Cladocarpus formosus*, which was obtained by the trawl from a depth of 775 fathoms in the seas lying to the south of Japan. The depth of 900 fathoms from which *Cladocarpus pectiniferus* was dredged is the greatest depth from which any member of the Plumularinæ has as yet been obtained; *Polyplumaria pumila*, *Aglaophenia filicula*, and *Aglaophenia acacia* are also deep-water species, having been all dredged in the Azoric Region from a depth of 450 fathoms. *Plumularia insignis* and *Plumularia abietina* were dredged off Marion Island, in the Region of the Cape of Good Hope, from a depth of from 150 to 310 fathoms; but none of the remaining species of the Plumularinæ came from greater depths than 150 fathoms, most of them from depths under 100 fathoms, while many are quite littoral and came from depths ranging between 8 and 20 fathoms.

The discovery of *Cladocarpus formosus* in the Japanese Region is a fact of considerable interest. This species had previously been obtained by the "Porcupine" from the deep cold area which lies between Shetland and the Færöe Islands, where it was dredged from a depth of 167 fathoms. *Cladocarpus formosus* thus affords an instance of the same species inhabiting two widely separated regions, with its absence, so far as we yet know, from all intervening stations.

The region of maximum development of the Plumularinæ, as far as this group is represented by the species brought home by the Challenger, is that of the East Indian, from which ten species were obtained. It is not, however, only from the number of species, but from the fact that the largest forms and most luxuriant colonies were brought from this region that we are justified in concluding that the conditions most favourable to the development of the Plumularinæ are here found. It is this region which has yielded the large Statoplean forms represented by *Acanthocladium huxleyi*, which attains a height of 15 inches, *Aglaophenia macgillivrayi*, of which a specimen in the collection has also a height of 15 inches, though it has lost the proximal portion of the colony, *Lytocarpus secundus*, which is more than $2\frac{1}{2}$ feet in height, and *Acanthella effusa*, which has a height of 12 inches. One large form, however, *Lytocarpus racemiferus*, was obtained off the coast of Bahia in the South Atlantic Region. It is among these large East Indian Plumularinæ that Semper has described certain species from the Philippine Islands which may probably be identified with *Aglaophenia macgillivrayi*, and *Lytocarpus secundus*, and which in consequence of their formidable stinging properties are held in dread by the natives.[1] Indeed the Philippine Islands appear to afford a habitat specially rich in these fine Hydroids. Off Samboangan, in this group, the trawl and dredge of the Challenger brought up seven species of Hydroids, all belonging to the Plumularinæ, and referable to four genera—*Plumularia*, *Acanthella*, *Aglaophenia*, and *Lytocarpus*.

Our knowledge of the geographical distribution of the Plumularinæ may be supplemented in some important points by the results of the United States exploration of the Gulf Stream. It appears from the dredgings carried on by that expedition that the Plumularinæ are largely represented in the Gulf of Mexico and West Indian seas. The combined results of the explorations made by the Challenger and by the United States expedition thus indicate for the Plumularinæ two centres of maximum development, an eastern centre which lies in the seas which surround the Philippines and other islands of the East Indian Archipelago, and a western centre which lies in the seas of the West Indian Islands, and in the warm waters which bathe the adjacent shores of Central and Equinoctial America. These points in the distribution of the Plumularinæ call to mind two nearly identical centres in which the Cheiroptera have their maximum of development, the Bats of the Old World attaining in the Region of the East Indian Islands that striking development which shows itself in the gigantic species which are so characteristic of the lands lying in that part of the globe, while these Old World Bats are represented by other groups of gigantic Bats which belong to the New World, and have their metropolis in the West Indian Islands and in the neighbouring lands of Central and Equinoctial America.

In comparing, however, the Challenger explorations with those carried on by the

[1] Semper, *loc. cit.*

United States in the Gulf Stream, we must not lose sight of the fact that the more limited area investigated by the latter allowed of a greater concentration of work and of more exhaustive examination than it seems possible for the Challenger to have bestowed on most of the stations comprehended in the vast area over which its explorations extended.

The detailed distribution of the Hydroids brought home by the Challenger will be seen from the following list of Stations and from the appended table, giving the Region which each species inhabited, and the depth from which it was taken.

STATION LIST.

The following is a list of the localities at which Hydroida were collected by the Expedition, with the physical conditions at each. In it are included the Plumularinæ described in the first part of this Report.[1]

STATION 23. Off Sombrero Island, March 15, 1873; lat. 18° 24′ N., long. 63° 28′ W.; depth, 450 fathoms; bottom, Pteropod ooze. Dredged.

Lafoëa dumosa.

STATION 24. Off Culebra Island, March 25, 1873; lat. 18° 38′ 30″ N., long. 65° 5′ 30″ W.; depth, 390 fathoms; bottom, Pteropod ooze. Dredged.

Cryptolaria flabellum. | *Sertularia catena.*

STATION 36. Off Bermuda, April 22, 1873; lat. 32° 7′ 25″ N., 65° 4′ 0″ W.; depth, 30 fathoms; bottom, coral. Dredged.

Campanularia insignis. | *Desmoscyphus gracilis.*

STATION 48. Off Halifax, Nova Scotia, May 8, 1873; lat. 43° 4′ N., long. 64° 5′ W.; depth, 51 fathoms; bottom, rock. Dredged.

Sertularia abietina. | *Thuiaria cupressina.*

STATION 73. Near the Azores, June 30, 1873; lat. 38° 30′ N., long. 31° 14′ W.; depth, 1000 fathoms; bottom, Pteropod ooze; bottom temperature, 39°·4. Dredged.

Cryptolaria humilis.

STATION 75. Near the Azores, July 2, 1873; lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms; bottom, volcanic mud. Dredged.

Polyplumaria pumila. | *Perisiphonia filicula.*
Aglaophenia filicula. | *Sertularia laxa* [*exigua*].
Aglaophenia acacia. | *Diphasia pinaster.*
Halecium beanii. | *Thuiaria pharmacopola.*

STATION 76. Off the Azores, July 3, 1873; lat. 38° 11′ N., long. 27° 9′ W.; depth, 900 fathoms; bottom, Pteropod ooze; bottom temperature, 40°. Dredged.

Cladocarpus pectiniferus.

[1] Zool. Chall. Exp., part xx.

Porto Praya, St. Iago; depth, 100 fathoms.

Streptocaulus pulcherrimus.

Station 101. Atlantic, south-west of Sierra Leone, August 19, 1873; lat. 4° 48′ N., long. 14° 20′ W.; depth, 2500 fathoms; bottom, blue mud; bottom temperature, 36°·4. Trawled.

Cryptolaria diffusa.

Station 122b. Off Barra Grande, Brazil, September 10, 1873; lat. 9° 9′ S., long. 34° 53′ W.; depth, 32 fathoms; bottom, red mud. Trawled.

Halicornaria plumosa.

Station 126. Off the Rio San Francisco, Brazil, September 12, 1873; lat. 10° 46′ S., long. 36° 8′ W.; depth, 770 fathoms; bottom, red mud.

Thuiaria hyalina.

Off Bahia; depth, probably 10 to 20 fathoms.

Aglaophenia calamus.
Lytocarpus racemiferus.
Campanularia ptychocyathus.
Thyroscyphus ramosus.
Sertularia cylindritheca.
Sertularia integritheca.
Desmoscyphus pectinatus.
Desmoscyphus obliquus.
Desmoscyphus acanthocarpus.
Idia pristis.

Station 135c. Off Nightingale Island, Tristan da Cunha, October 17, 1873; lat. 37° 25′ 30″ S., long. 12° 28′ 30″ W.; depth, 110 fathoms. Dredged.

Plumularia stylifera.
Halecium fastigiatum.
Antennularia fascicularis.
Sertularia leiocarpa.

Simon's Bay, Cape of Good Hope; depth, 10 to 20 fathoms.

Aglaophenia attenuata.
Halecium dichotomum.
Thuiaria pectinata.
Thecocladium flabellum.

Station 144a. Off Marion Island, December 26, 1873; lat. 46° 48′ 0″ S., long. 37° 49′ 30″ E.; depth, 69 fathoms; bottom, volcanic sand. Dredged.

Plumularia flabellum.

Station 145. Off Marion Island, December 27, 1873; lat. 46° 43′ 0″ S., long. 38° 4′ 30″ E.; depth, 50 to 100 fathoms; bottom, volcanic sand. Dredged.

Halecium flexile.
Grammaria insignis.

Station 145a. Off Marion Island, December 27, 1873; lat. 46° 41′ S., long. 38° 10′ E.; depth, 310 and 150 fathoms; bottom, volcanic sand. Dredged.

Plumularia insignis. | *Plumularia abietina.*
Staurotheca dichotoma.

Station 149. Off Accessible Bay, Kerguelen, January 9, 1874; depth, 20 fathoms.

Sertularia secunda [*unilateralis*].

Station 149d. Royal Sound, Kerguelen, January 20, 1874; lat. 49° 28′ S., long. 70° 13′ E.; depth, 28 to 60 fathoms; bottom, volcanic mud. Dredged.

Grammaria stentor. | *Sertularia echinocarpa.*
Sertularia articulata.

Station 149j. Off Cumberland Bay, Kerguelen Island, January 29, 1874; lat. 48° 43′ S., long. 69° 15′ E.; depth, 105 fathoms; bottom, volcanic mud. Dredged.

Schizotricha unifurcata. | *Eudendrium rameum.*
Halecium arboreum [*robustum*].

Off Kerguelen Island; depth, 10 to 60 fathoms.

Schizotricha unifurcata. | *Obelia geniculata.*
Hypanthea aggregata.

Station 150. Off Heard Island, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms; bottom, coarse gravel; bottom temperature, 35°·2. Dredged.

Campanularia tulipifera.

Station 151. Off Heard Island, February 7, 1874; lat. 52° 59′ 30″ S., long. 73° 33′ 30″ E.; depth, 75 fathoms; bottom, volcanic mud. Dredged.

Schizotricha multifurcata. | *Eudendrium vestitum.*
Sertularia exserta.

Station 160. South of Australia, March 13, 1874; lat. 42° 42′ S., long. 134° 10′ E.; depth, 2600 fathoms; bottom, red clay; bottom temperature, 33°·9. Trawled.

Halisiphonia megalotheca. | *Cryptolaria abyssicola.*

Station 161. Off Melbourne, April 1, 1874; lat. 38° 22′ 30″ S., long. 144° 36′ 30″ E.; depth, 33 fathoms; bottom, sand. Trawled.

Azygoplon rostratum.

Station 162. Off East Moncœur Island, Bass Strait, April 2, 1874; lat. 39° 10′ 30″ S., long. 146° 37′ 0″ E.; depth, 38 fathoms; bottom, sand and shells. Dredged.

Heteroplon pluma.
Diplocheilus mirabilis.
Calamphora parvula.
Desmoscyphus pectinatus.
Dictyocladium dichotomum.

Station 163a. Off Twofold Bay, Australia, April 4, 1874; lat. 36° 59′ S., long. 150° 20′ E.; depth, 150 fathoms; bottom, green mud. Trawled.

Plumularia laxa.
Perisiphonia filicula.
Halecium beanii.
Hypopyxis labrosa.

Station 163b. Off Port Jackson, June 3, 1874; lat. 33° 51° 15″ S., long. 151° 22′ 15″ E.; depth, 35 fathoms; bottom, hard ground; bottom temperature, 63°. Dredged.

Plumularia armata.
Halecium telescopicum.
Sertularia annulata.
Synthecium campylocarpum.
Synthecium alternans.

Station 169. Near New Zealand, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms; bottom, blue mud; bottom temperature, 40°. Trawled.

Cryptolaria gracilis.
Perisiphonia pectinata.

Station 173. Off Matuku, Fiji Islands, July 24, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; depth, 315 fathoms; bottom, coral mud. Dredged.

Cryptolaria geniculata.

Station 177. Off the New Hebrides, August 18, 1874; lat. 16° 45′ S., long. 168° 7′ E.; depth, 63 to 130 fathoms; bottom, volcanic sand; surface temperature, 78°·7.

Lictorella cyathifera.

Off Somerset, Cape York; depth, 8 to 2 fathoms. Dredged.

Sciurella indivisa.
Acanthella effusa.
Diplocyathus dichotomus.
Thyroscyphus simplex.
Lictorella halecioides.
Desmoscyphus obliquus.

Station 186. Flinders Passage, Torres Strait, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral mud. Dredged.

Lytocarpus spectabilis.
Thuiaria vincta.

STATION 188. Arafura Sea, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; bottom, green mud. Trawl and dredge both used.

Acanthocladium huxleyi.

STATION 190. Arafura Sea, September 12, 1874; lat. 8° 56′ S., long. 136° 5′ E.; depth, 49 fathoms; bottom, green mud. Trawled.

Acanthocladium huxleyi.

STATION 203. Off Panay, Philippine Islands, October 31, 1874; lat. 11° 6′ N., long. 123° 9′ E.; depth, 20 fathoms; bottom, mud.

Idia pristis.

STATION 212. Off Samboangan, Philippine Islands, January 30, 1875; lat. 6° 54′ N., long. 122° 18′ E.; depth, 10 fathoms; bottom, sand. Trawl and dredge both used.

Plumularia dolichotheca.
Acanthella effusa.
Aglaophenia macgillivrayi.
Aglaophenia coarctata.
Lytocarpus secundus.
Lytocarpus spectabilis.
Lytocarpus longicornis.

STATION 214. South of the Philippine Islands, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; depth, 500 fathoms; bottom, blue mud; bottom temperature, 41°·8. Trawled.

Sertularia producta [*geniculata*].

STATION 236. South of Japan, June 5, 1875; lat. 34° 58′ N., long. 139° 29′ E.; depth, 775 fathoms; bottom, green mud; bottom temperature, 37°·6. Trawled.

Cladocarpus formosus.

STATION 237. Near Yokohama, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; depth, 1875 fathoms; bottom, blue mud; bottom temperature, 35°·3. Trawled.

Monocaulus imperator.

STATION 244. North Pacific, June 28, 1875; lat. 35° 22′ N., long. 169° 53′ E.; depth, 2900 fathoms; bottom, red clay; bottom temperature, 35°·3. Trawled.

Stylactis vermicola.

Station 248. North Pacific, July 5, 1875; lat. 37° 41′ N., long. 177° 4′ W.; depth, 2900 fathoms; bottom, red clay; bottom temperature, 35°·1. Trawled.

Monocaulus imperator.

Honolulu; depth, 20 to 40 fathoms.

Campanularia retroflexa. | *Cryptolaria pulchella.*

Station 304. Port Otway, Patagonia, December 31, 1875; lat. 46° 53′ 15″ S., long. 75° 12′ 0″ W.; depth, 45 fathoms; bottom, green sand; surface temperature, 57°·2. Dredged.

Sertularia operculata.

Station 312. Off Port Famine, Patagonia, January 13, 1876; lat. 53° 37′ 30″ S., long. 70° 56′ 0″ W.; depth, 9 fathoms; bottom, blue mud. Dredged.

Halecium flexile. | *Hebella striata.*
Halecium cymiforme. | *Lafoëa fruticosa.*
Sertularia filiformis [*gracilis*].

Station 314. Near the Falkland Islands, January 21, 1876; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms; bottom, sand; bottom temperature, 46°. Trawled.

Grammaria magellanica. | *Sertularia implexa.*
Thuiaria quadridens.

Station 315. Port William, Falkland Islands, January 26, 1876; lat. 51° 40′ S., long. 57° 50′ W.; depth, 12 fathoms; bottom, sand, gravel. Dredged.

Obelia geniculata. | *Hypanthea hemispherica.*
Sertularia polyzonias.

Station 320. Off Monte Video, February 14, 1876; lat. 37° 12′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2. Trawled.

Sertularia clausa.

Station 344. Off Ascension Island, April 3, 1876; lat. 7° 54′ 20″ N., long. 14° 28′ 20″ W.; depth, 420 fathoms; bottom, volcanic sand. Dredged.

Cryptolaria crassicaulis.

GEOGRAPHICAL AND BATHYMETRICAL DISTRIBUTION OF THE SPECIES.

(The Numbers in the columns corresponding to the Geographical Regions refer to the Depths.)

	Britanno-Gallic.	Azoric.	Nova-Scotian.	West Indian.	Sargassic.	South Atlantic.	Cape of Good Hope.	Kerguelen.	Antarctic.	Australian.	East Indian.	Japanese.	North Pacific.	Mid Pacific.	South Pacific.	Fuegian.	Station or Locality.
Stylactis vermicola,	.	.	.	.	.	.	.	.	.	.	.	.	900				244.
Eudendrium vestitum,	.	.	.	.	.	.	.	75	.	.	.	.					151.
,, *rameum*,	.	.	.	.	.	.	.	105	.	.	.	.					149J.
Monocaulus imperator,	.	.	.	.	.	.	.	.	.	.	.	1875	900				337 and 348.
Halecium arboreum [*robustum*],	.	.	.	.	.	.	.	100	.	.	.	.					149J.
,, *telescopicum*,	.	.	.	.	.	.	.	.	.	30–35							163B.
,, *flexile*,	.	.	.	.	.	.	50	.	.	.	.	.	.	.	.	9	145 and 312.
,, *beanii*,	.	450	.	.	.	.	.	.	.	150							75 and 163A.
,, *fastigiatum*,	.	.	.	.	.	110											135C.
,, *dichotomum*,	.	.	.	.	.	.	10–20										Simon's Bay.
,, *cymiforme*,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	312.
Diplocyathus dichotomus,	.	.	.	.	.	.	.	.	.	.	8–12						Somerset, Cape York.
Campanularia insignis,	.	.	.	32													36.
,, *tulipifera*,	.	.	.	.	.	.	.	150									150.
,, *ptychocyathus*,	.	.	.	.	.	10–20											Off Bahia.
,, *retroflexa*,	.	.	.	.	.	.	.	.	.	.	.	.	.	20–40			Honolulu.
,, *chelonicæ*,	.																(?)
Obelia geniculata,	.	.	.	.	.	.	.	10–60	.	.	.	.	.	.	.	5–12	Off Kerguelen. Also 315.
Thyroscyphus ramosus,	.	.	.	.	.	10–20											Off Bahia.
,, *simplex*,	.	.	.	.	.	.	.	.		.	8–12						Somerset, Cape York.
Hypanthea aggregata,	.	.	.	.	.	.	.	20–26									Off Kerguelen.
,, *hemispherica*,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	5–12	315.
Calamphora parvula,	.	.	.	.	.	.	.	.	.	38							162.
Hebella striata,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	312.
Halisiphonia megalotheca,	.	.	.	.	.	.	.	.	.	2600							160.
Lafoëa dumosa,	.	.	.	450													23.
,, *fruticosa*,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	312.
Lictorella halecioides,	.	.	.	.	.	.	.	.	.	.	8–12						Somerset, Cape York.
,, *cyathifera*,	.	.	.	.	.	.	.	.	.	63–130							177.
Cryptolaria humilis,	.	1000															73.
,, *abyssicola*,	.	.	.	.	.	.	.	.	.	2600							160.
,, *flabellum*,	.	.	.	390													24.
,, *pulchella*,	.	.	.	.	.	.	.	.	.	.	.	.	.	20–40			Honolulu.
,, *crassicaulis*,	.	.	.	.	.	420											344.
,, *geniculata*,	.	.	.	.	.	.	.	.	.	.	315						193.
,, *gracilis*,	.	.	.	.	.	.	.	.	.	700							169.
,, *diffusa*,	.	.	.	.	2500												101.
Perisiphonia filicula,	.	450	.	.	.	.	.	.	.	150							75 and 163A.
,, *pectinata*,	.	.	.	.	.	.	.	.	.	700							169.
Grammaria stentor,	.	.	.	.	.	.	.	28–60									149D.
,, *magellanica*,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	70	314.
,, *insignis*,	.	.	.	.	.	.	50–100										145.
Sertularia filiformis [*gracilis*],	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	9	312.
,, *annulata*,	.	.	.	.	.	.	.	.	.	35							163B.
,, *leiocarpa*,	.	.	.	.	.	110											135C.
,, *secunda* [*unilateralis*],	.	.	.	.	.	.	.	20									149.
,, *clausa*,	.	.	.	.	.	600											320.
,, *implexa*,	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	70	314.

Sertularia laxa [*exigua*],			450															75.
,, *polyzonias*,																	12	315.
,, *exserta*,									75									151.
,, *echinocarpa*,									28–60									149D.
,, *catena*,					390													24.
,, *producta* [*geniculata*],											500							214.
,, *cylindritheca*,						10–20*												Off Bahia.
,, *integritheca*,						10–20*												Off Bahia.
,, *articulata*,									28–60									149D.
,, *operculata*,																45		304.
,, *abietina*,			51															48.
Diphasia pinaster,			450															75.
Thuiaria quadridens,																	70	314.
,, *pharmacopola*,			450															75.
,, *cupressina*,			51															48.
,, *vincta*,											8							186.
,, *pectinata*,							10–20											Simon's Bay.
,, *hyalina*,						770												126.
Desmoscyphus pectinatus,						10–20*				38								Off Bahia. Also 162.
,, *gracilis*,					30													36.
,, *obliquus*,						10–20*					8–20							Off Bahia. Also Somerset, Cape York.
,, *acanthocarpus*,						10–20*												Off Bahia.
Hypopyxis labrosa,										150								163A.
Staurotheca dichotoma,							310, 150											145A.
Dictyocladium dichotomum,										38								162.
Synthecium campylocarpum,										35								163B.
,, *alternans*,										35								163B.
Thecocladium flabellum,							10–20											Simon's Bay.
Idia pristis,						10–20*					20							Off Bahia. Also 202.
Plumularia flabellum,							69											144A.
,, *laxa*,										150								163A.
,, *dolichotheca*,											10							212.
,, *insignis*,							310, 150											145A.
,, *abietina*,							310, 150											145A.
,, *stylifera*,						110												135C.
,, *armata*,										35								163B.
Antennularia fascicularis,						110												135C.
Sciurella indivisa,											8–12							Somerset, Cape York.
Acanthella effusa,											8-12							Somerset, Cape York. Also 212.
Schizotricha unifurcata,									105									149J and off Kerguelen Island.
,, *multifurcata*,									10-60 75									151.
Polyplumaria pumila,			450															75.
Heteroplon pluma,										38								162.
Acanthocladium huxleyi,											28, 49							188 and 190.
Aglaophenia macgillivrayi,											10							212.
,, *filicula*,			450															75.
,, *attenuata*,							10–20											Simon's Bay.
,, *acacia*,			450															75.
,, *calamus*,						10-20*												Off Bahia.
,, *coarctata*,											10							212.
Lytocarpus racemiferus,						10–20*												Off Bahia.
,, *secundus*,											10							212.
,, *spectabilis*,											10							212.
,, *longicornis*,											10							212.
Streptocaulus pulcherrimus,					100													Porto Praya, St. Iago.
Diplocheilus mirabilis,										38								162.
Cladocarpus pectiniferus,			900															76.
,, *formosus*,												775						236.
Halicornaria plumosa,						32												122B.
Azygoplon rostratum,										33								161.

* Probable Depth.

DESCRIPTION OF GENERA AND SPECIES.

GYMNOBLASTEA.

Family BOUGAINVILLIDÆ.

Character of the Family. *Trophosome.*—Hydranths with conical hypostome, tentacles filiform in a single verticil.

Gonosome.—Gonophores, planoblasts or hedrioblasts.

Stylactis, Allman.

Stylactis, Allman, Ann. and Mag. Nat. Hist., May 1864

Generic Character. *Trophosome.*—Hydrocaulus rudimental, being reduced to short tubular processes which spring at intervals from a creeping stolon-like hydrorhiza and support the hydranths on their summit; hydrorhiza destitute of external cœnosarcal investment. Hydranths clavate, with a single circlet of filiform tentacles which surround the base of a conical hypostome.

Gonosome.—Gonophores adelocodonic, borne by the hydranth at the proximal side of the tentacles, or by the creeping stolon.

The genus *Stylactis* was founded for two Hydroids originally described by Sars,[1] who referred them to the genus *Podocoryne*. If, however, we accept the validity of the principles which have more recently guided the limitation and systematic position of Hydroid groups, these two species of Sars have really no claim to admission into the genus *Podocoryne*. The gonophores are adelocodonic and sedentary, while those of *Podocoryne* are medusiform planoplasts; and while the creeping stolon of the two species described by Sars is destitute of a cœnosarcal covering, that of *Podocoryne* agrees with *Hydractinia* in being overlaid by a naked fleshy extension of the cœnosarc.

To the two species made known by Sars I was enabled to add another from the Mediterranean,[2] and a fourth species has now been contributed by the dredgings of the Challenger.

[1] Faun. lit. Norv., p. 7, 1846, and Middelhavets lit. Fauna, p. 40.

[2] Gymnoblastic Hydroids, p. 305, 1871.

Stylactis vermicola,[1] n. sp. (Pl. I. figs. 2, 2*a*).

Trophosome.—Hydranths clavate, with a circlet of about eight tentacles, and with their rudimentary stems springing at short intervals from a creeping, loosely branched, stolon-like hydrorhiza which is destitute of spine-like appendages.

Gonosome.—Gonophores oviform, shortly pedunculate, springing from the hydranth close to its proximal end, or from the hydrorhiza.

Locality.—Station 244, North Pacific; lat. 35° 22′ N., long. 169° 53′ E.; depth, 2900 fathoms.

Stylactis vermicola derives special interest from its singular habitat as well as from the great depth at which it was found living. Professor M'Intosh, while engaged with his Report on the Annelids collected by the Challenger, found that a colony of Hydroids had attached itself to the back of a specimen of *Lætmonice producta*, an *Aphrodita*-like Annelid obtained by the trawl in the North Pacific, from a depth of 2900 fathoms. The Hydroid lay entirely under cover of the scales, which are disposed in two imbricated series over the back of this Annelid, and an examination of a specimen sent to me by Professor M'Intosh has shown it to be an undescribed species of *Stylactis*.

The hydrorhizal stolon crept over the back of the Annelid and was crowded with thick, club-shaped hydranths of various sizes and in various stages of contraction. From the creeping stolon numerous very short tubular offsets were emitted. These formed so many rudimental stems which were invested like the hydrorhiza with a perisarc, while each supported on its summit a claviform hydranth, with about eight filiform tentacles disposed in a single circlet round the base of a thick conical hypostome.

Some of the hydranths gave support to gonophores which were carried on very short peduncles close to the proximal end of the hydranth, while similar short-peduncled gonophores were also borne by the hydrorhiza close to the base of a hydranth. No difference either in form or size could be seen between those hydranths which carried gonophores and those which were without them.

Family EUDENDRIDÆ.

Character of the Family. Trophosome.—Hydranths with trumpet-shaped hypostome, tentacles filiform in a single verticil.

Gonosome.—Gonophores hedrioblastic.

[1] It is to this species that allusion has been made in the Narrative of the Cruise (vol. i. part ii. p. 753), where it is spoken of as referable to a new Calyptoblastic genus. More mature consideration has led me to believe that it has no characters which would justify its separation from *Stylactis*, the generic group in which it is here included.

Eudendrium, Ehrenberg (in part).

Eudendrium, Ehrenberg, Corall. Rothen Meeres, p. 72.

Generic Character. Trophosome.—Colony dendritic; hydrocaulus invested with a well-developed perisarc. Hydranths with a trumpet-shaped hypostome, which is surrounded by a single verticil of filiform tentacles.

Gonosome.—Gonophores adelocodonic, developed from the body of the hydranth at the proximal side of the tentacles, or from the sides of the hydrocaulus, monothalamic in the female colony, polythalamic in the male.

The genus *Eudendrium* was separated by Ehrenberg from *Tubularia*, with which it had been previously confounded. Its foundation as an independent genus is quite in accordance with its structural characters, though the grounds on which Ehrenberg believed himself justified in insisting on it are derived from characters comparatively trivial and destitute of generic value. The genus as defined by Ehrenberg accordingly contains forms which cannot be generically associated in a natural system. It was reserved for subsequent systematists, especially van Beneden and Strethill Wright, to indicate the true grounds of the revision, the most important of which, so far as concerns the trophosome, are found in the trumpet-shaped hypostome with its single verticil of tentacles.

Among the comparatively small number of Gymnoblastic Hydroids admitting of determination in the collection of the Challenger, are two species of *Eudendrium*—one a well-known European species, the other an undescribed species presenting some remarkable and distinctive characters.

Eudendrium vestitum, n. sp. (Pl. I. figs. 1, 1*a*).

Trophosome.—Hydrocaulus slender, monosiphonic, much branched, branches alternate, dilated at the summit and with the perisarc extended over the base of the hydranths. Hydranths partially retractile within the dilated summit of the branches.

Gonosome.—Gonophores (female ?) oviform, pedunculate, springing from the sides of the branches.

Locality.—Station 151, off Heard Island; depth, 75 fathoms.

The specimen of *Eudendrium vestitum* contained in the collection forms a dense tuft of slender profusely branched stems fixed to the detached spine of an Echinus, and attaining a height of about three-fourths of an inch. The branches are given off at a high angle and are remarkable for the way in which their chitinous perisarc is continued over the base of the hydranths, so that these when contracted have the appearance of being partly enclosed in a chitinous cup which recalls in some respects the hydrotheca of the Calyptoblastea. Here, however—a condition which has its parallel in certain species of *Perigonimus* and in some allied forms—the perisarc is adherent for a greater

or less extent to the body of the hydranth, and does not form as in a true hydrotheca a detached receptacle from the walls of which the hydranth is entirely free.

The gonophores are borne singly on rather long peduncles which spring from the sides of the branches, at variable distances below the hydranth. Though the opacity of the perisarcal clothing of the gonophores rendered it impossible to determine the nature of their contents with sufficient certainty to remove all doubt as to their sex, we may safely assume that like similar bodies in other species of *Eudendrium* they enclose ova, the male gonophores in *Eudendrium*, so far as has been hitherto observed, differing from these in form and arrangement.

The perisarc, not only in the trophosome but in its extension over the gonophores, is of a dull brown colour, and is so opaque that a view of the included parts cannot be obtained through it. In these respects, as well as in the long-peduncled oviform gonophores distributed along the ultimate ramuli, *Eudendrium vestitum* forcibly recalls the general facies of *Bimeria vestita;* from which, however, it is separated by the form of its hypostome, which presents the condition of a distinctly differentiated trumpet-shaped appendage characteristic of *Eudendrium*, instead of being a simple fusiform extension of the hydranth as in the Bimeridæ.

Eudendrium rameum (Pallas) (Pl. II. figs. 1, 2).

Tubularia ramea, Pallas, Elenchus, p. 83.
Eudendrium rameum, Johnston, Brit. Zooph., p. 43, 1847.

Trophosome.—Hydrocaulus profusely and for the greater part of its extent very irregularly branched, main stem and principal branches strongly fascicled, but becoming monosiphonic distally where the irregular ramification gives place to an alternate disposition of the ramuli; monosiphonic ramuli with several distinct annulations at their origin, and often with one or more groups of annulations at variable distances along their length. Hydranths with about sixteen tentacles.

Gonosome not present.[1]

Locality.—Station 149J, off Cumberland Bay, Kerguelen Island; depth, 105 fathoms.

I can find no character which would justify the separation of the Hydroid which has afforded the subject of the description here given from the *Tubularia ramea* of Pallas = *Eudendrium rameum* of Johnston, a species by no means rare on the British coast. It is true that no gonosome is present in the Kerguelen specimen, and the want of this essential part of the colony renders the identification of the species less certain than it would otherwise be. In the absence, however, of any character inconsistent with the determina-

[1] In the gonosome, as observed in British specimens, the male gonophores are two-chambered, borne on the body of the hydranth in a verticil immediately below the tentacles; the female are oviform, scattered on the hydrocaulus for some distance below the hydranth.

tion here adopted, we may safely regard the Kerguelen Hydroid as specifically identical with the European.

Endendrium rosetum is eminently dendritic in its habit, and the tree-like disposition of its zooids, in an assemblage which so forcibly recalls the physiognomy of some of the most characteristic forms of the vegetable kingdom, may well justify the appellation of "zoophyte" by which the Hydroida have been designated in the writings not only of the earlier observers but in those of many zoologists of our own day.

The Kerguelen specimen has a height of between 5 and 6 inches, and the fascicled stem has a diameter of nearly a quarter of an inch at its base.

Family MONOCAULIDÆ.

Character of the Family. Trophosome.—Tentacles filiform, in two sets, a proximal and a distal. Hydrocaulus solitary, naked.

Gonosome.—Gonophores hedrioblastic.

Monocaulus, Allman.

Monocaulus, Allman, Ann. and Mag. Nat. Hist., May 1864.

Generic Character. Trophosome.—Hydrocaulus solitary, naked. Hydranths abruptly distinct from the hydrocaulus, with a proximal and a distal set of filiform tentacles; proximal set longer than the distal, and disposed in a single verticil near the base of the hydranth, the distal set scattered over a zone close to the summit of the hydranth.

Gonosome.—Gonophores in the form of simple sacs borne upon pedunceles which spring from the body of the hydranth between the proximal and distal sets of tentacles.

The genus *Monocaulus* was constituted for the *Corymorpha glacialis* of Sars, a form which, though its trophosome is that of a *Corymorpha*, is distinguished from that genus by the condition of its gonophores, which are adelocodonic, or in the form of simple closed sacs, instead of being as in every true *Corymorpha* phanerocodonic or medusiform.

Monocaulus imperator, Allman (Pl. III. figs. 1–7).

Monocaulus imperator, Allman, Narr. Chall. Exp., vol. i. p. 753, fig. 265, 1885.

Trophosome.—Hydranth about an inch and a half in height, separated by a deep constriction from the hydrocaulus; proximal tentacles about 4 inches in length, scarcely retractile, pendulous, about one hundred in number; distal tentacles about half an inch in length, contractile, forming a dense fringe round the mouth, forty-eight or fifty in number. Hydrocaulus about half an inch in diameter, very extensile, and when fully extended many feet in height, marked by undulating longitudinal striæ, nearly

cylindrical, but enlarging at its proximal end into a bulbous expansion which gives off from its base a dense plexus of capilliform tubes.

Gonosome.—Gonophores ovate, borne in clusters on short, closely crowded, branching peduncles, which spring from a zone just above the base of the proximal circlet of tentacles.

Localities.—Station 237, off Yokohama, Japan; lat. 34° 37′ N., long. 140° 32′ E.; depth, 1875 fathoms.

Station 248, North Pacific; lat. 37° 41′ N., long. 177° 4′ W.; depth, 2900 fathoms.

The magnificent species of *Monocaulus* to which the name of *imperator* has been here assigned was obtained in the North Pacific Ocean, from the enormous depths of 1875 and 2900 fathoms. It far exceeds in size all known Hydroids. One of the specimens captured had its dimensions noted by Sir Wyville Thomson and Mr. Moseley immediately after being brought on board, and was found to measure 9 inches from tip to tip of the tentacles which form the proximal circlet, while its stem rose from its point of attachment to a height of 7 feet 4 inches. As Sir Wyville Thomson remarked, however, in a letter to myself describing the capture, the animal was measured as it lay extended over the surface of the trawl net, and though, of course, capable in life of becoming extended to the length then measured, this may not have represented the height habitually assumed by it. When in the state of extension which would seem to be normal to it the stem had a diameter of about half an inch.

Immediately after the capture a drawing of one of the specimens was made by Mr. Wild, the artist of the expedition, and it is fortunate that this precaution had been taken, for though the specimens were at once put into spirits they have lost almost every character of importance. Indeed, Sir Wyville Thomson, writing to me from on board the Challenger soon after the capture of the great Hydroid, says "these delicate things, drawn up rapidly through the water from a depth of nearly four statute miles, and transported into such totally different conditions of temperature, pressure, &c., suffer greatly from this violent change. They are, in fact, almost knocked to pieces, and their fine tissues are in a nearly deliquescent state, so that our great anxiety is to put them at once into some reagent which may tend to harden them. It is wretched to see them melting away absolutely under our eyes. When put into any of our fluids they at once contract out of all form. But this cannot be helped, and I thought it best that you should have them as well preserved as we could manage, so I only gave them a cursory glance and sent them on."

Notwithstanding the impossibility of preserving the animal in anything like a satisfactory state, some points by no means without interest have been made out in its structure. One of the most important of these is the fact that the stem, instead of having its axis occupied by a pith-like core as in *Corymorpha*, contains a wide cavity

which extends through its entire length, and enlarges into a bladder-like receptacle at the base. Sir Wyville Thomson informed me that, when living, liquid was seen to gravitate down the stem, and collect in the basal expansion.

The cavity which thus occupies the axis of the stem is lined by the endoderm (fig. 4, *c*), of which, however, only traces remained in the specimens. The cells of which this is composed seem to have contained coloured granules, and it must have been traversed by the longitudinal canals (*d*) which, as in *Corymorpha*, represent the proper body cavity. Such at least may be inferred from the presence in *Monocaulus imperator* of the longitudinal striæ which in *Corymorpha* are the external expression of the internal canals. These striæ, as Sir Wyville Thomson informed me, were very well marked in the living animal, and they are so represented in Mr. Wild's drawing. In the specimens as they reached me, however, rather faint indications of the canals were all that could be obtained.

Immediately external to the endoderm lies a very remarkable tissue (figs. 4, *b*, 5, *a*, and 6). Indeed the presence of this tissue is probably the most striking feature in the histology of the Hydroid. It shows itself in the form of a fibrillated membrane whose most marked property is its extraordinary elasticity. The fibres of which it is composed take a circular course and are comparatively thick, about $\frac{1}{500}$th of an inch in diameter, and are resolvable into finer fibrillæ, but are otherwise homogeneous (fig. 6).

Besides this fibrillated structure no other histological elements can be detected in the elastic tissue, which forms a transparent, colourless, and comparatively thick layer extending through the whole length of the stem. It is of a firm, even cartilaginous consistence, and its elasticity is such that separated portions of the stem-wall curl up forcibly on themselves. Sir Wyville Thomson describes the stem in the living animal as "enormously extensile." This extensibility is to a great extent retained in the dead specimen, in which the longitudinal extension of the stem is permitted by the elastic layer, which, when the extending force is withdrawn, brings back the stem to its previous length. Though the course of the fibres of the elastic layer is transverse, its elasticity would thus appear to exert itself in antagonising longitudinal as well as transverse extension of the stem. The elasticity, however, is more strongly marked transversely, or in the direction of the component fibres by which the stem in the dead animal is thrown into irregular longitudinal flutings (fig. 7). Though it is pretty certain that in the living animal the elastic layer must be associated with a proper contractile tissue, which it antagonises and controls, the state of the specimens did not allow any trace of this to be detected.

Resting on the outer side of the elastic layer is the ectoderm (figs. 4, *a*, 5, *b*), consisting of a single layer of loosely aggregated cells, irregular in form and size, and with granular contents which in the preserved specimens were opaque and of a brown colour. This layer would seem to be in direct contact with the surrounding water, for nothing like a

perisarc, even in the condition of the thin pellicle which occurs in *Corymorpha*, could be detected.

I regard the elastic tissue of *Monocaulus imperator* as the homologue of the mesosarc, or supporting lamella, differing, however, from this layer as it shows itself in every other known instance by its massive development, its more decidedly fibrillated structure, and its great elasticity.

I could find no trace of the papilliform processes which in *Corymorpha*, and in at least one species of *Monocaulus*, are developed near the base of the stem. In *Monocaulus imperator*, however, the stem sent off from its proximal end a multitude of fine capillary tubes which, unlike the stem, were each invested by a very delicate chitinous pellicle, and were aggregated into a dense terminal plexus.

The tentacles composing the proximal circlet as noted by Sir Wyville Thomson were in life about 4 inches long, almost transparent, and in most instances of a pale pink colour, while the mass of gonophores which lay just above their base was of a maroon colour. The colour of the stem in the recent animal was in most of the specimens a pale pink, becoming darker towards the base.

The specimens when brought up were for the most part found to have the proximal extremity coated with mud, a fact which renders it pretty certain that in its natural attitude this gigantic *Monocaulus* lives with its proximal end plunged into the muddy sea bottom.

With regard to the associates of *Monocaulus imperator*, the editor gives the following list from the same dredging. Actiniaria:—*Paractis tubulifera*, *Liponema multiporum*, *Cereus spinosus*, and *Porponia robusta*; Asteroidea:—*Porcellanaster tuberosus* and *Hyphalaster inermis*; Echinoidea:—*Phormosoma tenue*; Ophiuroidea:—*Ophioglypha orbiculata*, *Ophioglypha sculptilis*, and *Ophiomusium granosum*; Holothurioidea:—*Holothuria thomsoni*; Brachiopoda:—*Terebratula dalli* and *Discina atlantica*; Mollusca:—*Malletia dunkeri*, *Glomus japonicus*, *Arca* (*Barbatia*) *pteroessa*, *Pleurotoma* sp., and *Octopus januarii*; Fish:—*Neobythites grandis*, *Macrurus asper*, *Macrurus altipinnis*, *Macrurus liocephalus*, *Gonostoma microdon*, and *Bathysaurus mollis*; in addition to *Phoxichilidium mollissimum*, *Scalpellum vitreum*, and a number of other Crustacea which perhaps may not have come from the bottom. All the above were new species, with the exception of the *Discina*.

CALYPTOBLASTEA.

Family HALECIIDÆ.

Character of the Family. Trophosome.—Hydrothecæ replaced by shallow saucer-shaped pedunculate appendages (hydrophores). Hydranths with conical hypostome.

Gonosome.—Gonophores hedrioblastic.

Halecium, Oken.

Halecium, Oken, Lehrbuch d. Naturgesch., 1815.

Generic Character. Trophosome.—Colony dendritic, with fascicled or monosiphonic stem. Hydrothecæ replaced by shallow pedunculated cups (hydrophores), too small to receive the hydranths in retraction. Sarcothecæ not present.

Gonosome.—Gonophores adelocodonic. Gonangia with terminal or lateral orifice.

There is no more natural and definitely marked genus among the Calyptoblastic Hydroids than that of *Halecium*, with two or three others which must be united with it in one and the same family. The hydrotheca so well developed in other Calyptoblastea is in these genera rudimental, being reduced to the condition of a peduncle, with its distal end expanded so as to form a very shallow membranous cup, quite incapable of receiving the hydranth, even in its state of extreme retraction. The term hydrotheca is thus inapplicable to it, and that of "hydrophore" may be conveniently used to designate the peduncle with its terminal expansion or "limbus."

The primary hydrophore is always immovably fixed by its base to the hydrocaulus, but in most cases it becomes, with the growth of the colony, prolonged by the successive formation of new hydrophores which originate within the limbus of the preceding one, and the primary hydrophore is thus extended by a succession of similar segments piled one on the other in a single continuous series, which is strongly suggestive of a telescope with its tubes drawn out.

The limbus of the hydrophore is in almost every instance ornamented by minute refringent puncta which run round its walls in the form of a circular wreath. What may be their meaning is unknown, but that they are not without significance may be assumed from the constancy of their occurrence. They are found in the most widely separated species, in species in which the limbus is least developed as well as in those in which this part is most obvious, and occur not only in *Halecium* proper but in forms which, though belonging to the same family, must be placed in different genera. Among the various species which I have had an opportunity of examining, there is only one (*Halecium cymiforme*, Pl. VII.) in which I have failed to detect them.

The gonangia of *Halecium* spring in some cases from the proximal or primary segment of a hydrophore, sometimes from the side of a branch, and sometimes as a continuation of its distal end. The orifice is sometimes terminal, sometimes lateral, and there is probably always a difference of form between the gonangia of male and female colonies. In some cases the blastostyle develops from its expanded summit on the outer side of the gonangium a pair of well-formed hydranths with tentacles and mouth, a remarkable phenomenon of which we have no other example in any Hydroid.

In the family of the Haleciidæ must be included a beautiful Hydroid obtained by the Challenger, and forming the type of a new genus, *Diplocyathus* (Pl. VIII.). In the same

family the remarkable genus *Ophiodes* of Hincks will also find a place, while I am strongly of opinion—though I have had no opportunity of examining a specimen—that we ought to bring into the same association the singular genus, *Hydranthea*, Hincks, which Mr. Hincks places among the Gymnoblastic Hydroids.

Halecium robustum, n. sp. (Pl. IV. figs. 1–3).

Trophosome.—Colony attaining a height of upwards of eight inches; stem profusely and irregularly branched, with the branches extending for the most part, but not exclusively, in a single plane; main stem and principal branches very thick, fascicled; ultimate branches monosiphonic, disposed in alternate pinnæ, each springing from the side of the basal segment of a hydrophore; pinnæ divided into short internodes by obliquely transverse joints, each internode supporting on alternate sides a hydrophore with a very narrow non-everted limbus; basal segment of hydrophore adnate by its side to the hydrocaulus. Hydranths very large, with about eighteen tentacles.

Gonosome not present.

Locality.—Station 149J, off Cumberland Bay, Kerguelen Island; depth, 105 fathoms.

This is a large and very robust form, the stem towards the root measuring a quarter of an inch in diameter, and the principal branches two-tenths of an inch. The primary segment of the hydrophore is adnate to the internode, and is frequently prolonged by two or three supplementary tubuli. The limbus of the hydrophore is exceedingly narrow, and is marked by a girdle of minute brilliant points.

The presence of a zone of refringent puncta on the almost evanescent limbus of the hydrophore of *Halecium robustum* points to the all but universal presence of this apparently insignificant character throughout *Halecium* and its immediate allies. In only one instance among the various species of *Halecium* which I have examined have I failed to detect these puncta, though the specimens had been obtained from very various and widely distant localities.

The soft parts are in this fine species, as in almost all the Haleciidæ contained in the collection, sufficiently well preserved to admit of the form of the hydranth being observed in most of its important features.

Halecium telescopicum, n. sp. (Pl. V. figs. 1, 1*a*).

Trophosome.—Hydrocaulus irregularly branched, with the branches given off nearly in one plane. Hydrophores with the limbus narrow and slightly everted, and with the first of the accessory segments provided with two oblique annuli at its base.

Gonosome not present.

Locality.—Station 163B, off Port Jackson; depth, 30 to 35 fathoms.

The branches of this species are very slender and flaccid, and the internodes of

moderate length. The hydrophores are often very much extended by the superposition of consecutive segments, as many as nine such segments being occasionally present. The basal or primary segment is not adnate by its side to the hydrocaulus. The first of the accessory segments, or that which immediately succeeds the primary segment, is usually the longest, and is always provided with two oblique annuli at its base. The branches spring from the sides of the primary segments of the hydrophores. The fasciculation of the stem and larger branches would seem to cease soon, leaving an extensive portion of the colony to be continued in a monosiphonic condition for the remainder of its course.

The specimen consists of a portion of a colony about two inches in height, and it is probable that the height attained by the entire colony does not much exceed that of the specimen.

Halecium flexile, n. sp. (Pl. V. figs. 2, 2*a*).

Trophosome.—Hydrocaulus attaining a height of about four inches; main stem and principal branches fascicled, becoming monosiphonic towards the distal portion of the colony, slender and flexile; ramification pinnate and alternate, every branch springing from the base of a hydrophore, divided by oblique joints into moderately long internodes, each internode with a shallow annular constriction at its proximal end. Hydrophores cylindrical, usually prolonged by several consecutive similar segments.

Gonosome.—Gonangia (male ?) oboviform capsules springing by a short peduncle from the side of the basal segment of the hydrophore, and provided with a terminal orifice.

Locality.—Station 145, off Marion Island; depth, 50 fathoms.

Station 312, Port Famine, Patagonia; lat. 53° 37′ 30″ S., long. 70° 65′ 0″ W.; depth, 9 fathoms.

This is a flexile and graceful species, thus contrasting in its habit with the rigidity which is characteristic of many species of *Halecium*. The hydrophores have their basal segment standing out free from the internode, while they are in almost every instance prolonged by the superposition of several similar segments.

The soft parts were sufficiently well preserved in the specimens to allow of their more important details of form being observed. The hydranths, which are very large, have, as in other species of *Halecium*, a well-defined, thick, fusiform dilatation of the body just behind the tentacles. These spring from the margin of an expanded disc, which on its upper side carries the conical hypostome, and are about twelve in number.

Two very different localities, Marion Island and the region off Tierra del Fuego, have yielded specimens of *Halecium flexile;* at least I do not hesitate in referring the specimens from both of these localities to the same species, for though no gonosome is present in the examples coming from the region of Tierra del Fuego, the trophosome of these is specifically indistinguishable from that of the others.

Halecium beanii, Johnston (Pl. XII. figs. 3, 3*a*).

Halecium beanii, Johnston, Brit. Zooph., ed. 2, p. 59, pl. ix.
„ „ Hincks, Brit. Hydroid Zooph., p. 224, pl. xliii. fig. 2.

Trophosome.—Hydrocaulus attaining a height of three inches; main stem and principal branches fascicled, becoming monosiphonic distally; main stem irregularly branched, the smaller ramuli pinnately disposed, and for the most part carrying secondary and tertiary pinnæ, ultimate ramuli very slender. Hydrophores commencing with a short basal offset from the distal end of each internode, and almost always continued by a consecutive series of short superimposed tubes, each slightly widening upwards and ending in a narrow everted limbus.

Gonosome.—Gonangia springing each by a very narrow base from the side of an internode close to the origin of a hydrophore; female slipper-shaped, with tubular lateral orifice; male elongate, ovoid, with terminal orifice.[1]

Locality.—Station 75, off the Azores; lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms.

Station 163A, off Twofold Bay; lat. 36° 59′ S., long. 150° 20′ E.; depth, 150 fathoms.

The slenderness of the ramuli in the monosiphonic portion of the colony and the slipper-shape form of the female gonangia afford distinguishing characteristics of the present species. The general ramification of the colony is in a single plane, and the ramuli spring each from a point on the side of an internode close to the base of a hydrophore. The number of superimposed segments in the hydrophore is usually very considerable and may amount to as many as seven or eight. The limbus of the hydrophore, though narrow, possesses the wreath of brilliant puncta characteristic of the genus and its allies.

The slipper-shaped form of the female gonangia, though this condition is not confined to the present species, is remarkable and characteristic. The quadrate orifice, instead of being as in most cases terminal, is here placed near the middle of the side which faces the branch, and is raised upon the summit of a short tube. The point from which the gonangium springs is situated close to the origin of a hydrophore, and corresponds exactly to the origin of a branch whose place is thus taken by the gonangium.

Halecium beanii is one of the few British Hydroids brought home by the Challenger. It was obtained during the voyage from two localities; one of these was in the neighbourhood of the Azores, where it occurred at a depth of 450 fathoms, the other off the south-east coast of Australia at a depth of 150 fathoms.

[1] As seen in European specimens. No male gonosome occurs among the specimens of *Halecium beanii* brought home by the Challenger.

Halecium fastigiatum, n. sp. (Pl. XV. figs. 2, 2*a*).

Trophosome.—Hydrocaulus with the main stem and principal branches fascicled, becoming monosiphonic and slender towards their distal extremities; ramification profuse and irregular, with the branches given off in different planes and at a high angle.

Gonosome.—Gonangia (male) springing from the side of the basal segment of the hydrophores, sessile, compressed goblet-shaped, deep.

Locality.—Station 135c, off Nightingale Island, Tristan da Cunha; depth, 110 fathoms.

This is a slender and flexile species. The specimens are but fragmentary and destitute of hydrorhizal extremity, and the largest has a height of upwards of two inches. The branches, which like the gonangia spring from the fixed basal segment of the hydrophore, are given off at an acute angle and become directed in various planes. The internodes are of moderate length.

The hydrophores usually present two or three superimposed segments, but are often formed alone by the fixed lateral process of the stem, which then carries the hydranth directly. The segments are of variable length and the limbus is well developed. The wreath of brilliant points just within the margin is distinct. The hydranths are large and were well preserved in the specimen, where they might be observed in various states of extension.

The gonangia are large, their height being nearly twice that of an internode. They spring, as is usual in the genus, from the basal segment of the hydrophore. When viewed in the plane of the hydrophores they present the outline of a deep wide-mouthed goblet, slightly everted towards the rim, and narrowed at their point of attachment without forming a distinct peduncle. When viewed in a plane at right angles to this they are seen to be much compressed.

The gonangia present in the specimen were those of a male colony. The blastostyle carried a single sporosac, which projected for some distance through the orifice of the gonangium.

Halecium dichotomum, n. sp. (Pl. VI. figs. 1–4).

Trophosome.—Hydrocaulus consisting of jointed stems which branch dichotomously and are continuous at their proximal ends with a plexus of branching and intercommunicating tubes; internodes of stem long and cylindrical, branches given off close to the distal ends of the internodes. Hydrophores either direct continuations of the internodes, or springing from the sides of the tubes which form the basal plexus, nearly cylindrical, with a few annular rugæ at the base, and with very narrow, scarcely everted limbus.

Gonosome.—Gonangia (female) springing each by a short peduncle from the sides

of the hydrophores, pyriform, with a lateral tubular orifice and rounded summit, or with the summit broadly truncate, regularly and distinctly annulated throughout.

Locality.—Simon's Bay, Cape of Good Hope; shallow water.

Halecium dichotomum is a very distinct and remarkable species. The beautifully annulated condition of the gonangia presents a character not elsewhere met with in *Halecium*. In the general architecture of the hydrocaulus, and in the plexus of tubes with which the proximal ends of the stems are continuous, *Halecium dichotomum* closely approximates to *Halecium cymiforme* (Pl. VII.), but presents a combination of characters which separate it by a wide interval from every other known species of *Halecium*.

The stems, which rise free from the basal plexus to a height of from about half an inch to an inch, consist of a series of cylindrical tubes, each tube springing from a point close to the distal end of that which precedes it. These tubes represent the internodes of the stem, but instead of being as in other cases directly continuous with one another, they have their distal ends free. Each of these ends either directly supports a hydranth —the entire internode thus representing the basal segment of a hydrophore—or is continued by one or more superimposed segments. The stem may thus be regarded as a series of long, nearly straight, cylindrical hydrophores, either simple or extended by the superposition of accessory segments, each hydrophore springing, one from the other, so close to the distal end of that which precedes it, and at so high an angle, as to form a geniculate linear series. The long cylindrical internodes which in this way make up the stem are often prolonged by two instead of a single internode, both springing opposite to one another from points close to the distal end. Two branches which exactly repeat that from which they spring are thus formed, and give the dichotomous character to the ramification of the colony.

The basal plexus consists of an entangled mass of tubes whose branches unite freely with one another. These tubes, though their diameter is scarcely less than that of the stem, do not present the regular succession of internodes met with in the latter. Their walls are marked by rather irregular annular rugæ. They give off hydrophores which spring here and there from their sides, and some of these as in the hydrophores of the stem support laterally situated gonangia.

The fascicled condition of the stem found in most species of *Halecium* is usually but slightly marked in *Halecium dichotomum*, though some of the old stems may become very much branched and fascicled. The fasciculation, however, is in most cases chiefly confined to the basal plexus, where two or three tubes may here and there be seen united by their sides to one another.

The gonangia present a slight difference in form. While the greater number have the summit rounded and arched over the lateral orifice, this part is in others broadly truncate. The difference is probably dependent on different degrees of maturity; at all

events it does not, as might be supposed, indicate a difference of sex, ova being present in both forms.

Like most of the examples of *Halecium* contained in the collection, the present species had its soft parts fairly well preserved, so that the general form of the hydranths could be delineated while the germinal vesicle and spot were quite distinct in the ova.

The collection contained no example of a colony with male gonosome.

Halecium cymiforme, n. sp. (Pl. VII. figs. 1–5).

Trophosome.—Hydrocaulus a very slender sub-dichotomously branched stem, which springs from a bundle of creeping tubular filaments. Hydrophores borne on the summits of the branches, and with a moderately wide, reflexed limbus.

Gonosome.—Gonangia (male ?) pyriform, compressed, borne like the hydrophores on the summits of the branches, and having their contents crowned with a cap which disappears as the gonophore advances towards maturity.

Locality.—Station 312, Port Famine, Patagonia; lat. 53° 37′ 30″ S., long. 70° 56′ 0″ W.; depth, 9 fathoms.

Halecium cymiforme presents a multitude of very slender branches of uniform thickness, each springing from a point near the distal end of its predecessor, the whole forming a combination not unlike what may be seen in certain forms of the definite inflorescence known to botanists as a cyme. Usually two small branches are given off close to one another near to the distal end of the preceding one, thus giving a dichotomous character to the ramification.

The hydrorhizal portion of the specimen examined consisted of numerous tubular filaments, which ran in close apposition to one another along the stems and branches of another Hydroid, giving off from distance to distance their slender stems, which soon began to multiply by ramification, and which scarcely differed in diameter from the hydrorhizal filaments from which they sprang. The branches are provided with a few annulations at their origin, and occasionally a few in the course of their length; but they present no true joints, and we must regard the entire hydrocaulus as composed of a succession of internodes, each springing laterally from its predecessor, instead of being in direct continuation with it. The ramification of *Halecium cymiforme* is thus very similar to that which occurs in *Halecium dichotomum*. The distal extremity of every internode or segment of the ramification is free, and becomes in some cases continued into a hydrophore, while in others it carries a gonangium.

The hydrophores are represented by the free ends of the segments crowned by a limbus whose extreme rim is usually reflexed, and are frequently continued by one or two accessory hydrophores. The wreath of brilliant points, by which the limbus of the hydrophore is in the genus *Halecium* almost universally ornamented, cannot here be detected.

The mode in which the hydrophores form direct continuations of the segments of the stem is quite similar to the condition met with in *Halecium dichotomum*.

The gonangia are for the most part borne in an entirely similar way on the free summits of the segments of the ramifications, thus taking the places which in other parts of the colony are occupied by the hydrophores. Gonangia are also occasionally borne on the summits of short lateral branches given off close to the free end of the segment.

The gonangia present in the specimen appeared to be male, and their contents exhibited some curious and interesting features. Through the axis of the compressed pyriform gonangium the blastostyle (figs. 4 and 5, *a*) extends as a continuation of the cœnosarc of the stem, and soon emits from its side a single gonophore (figs. 4 and 5, *b*) which continues to be surrounded by an ectodermal envelope (figs. 4 and 5, *c*) from the sides of the blastostyle. The distal half of the cavity of the gonangium is occupied by a remarkable structure which lies like a cap over the summit of the gonophore, and consists of two concentric but laterally compressed hollow thick-walled hemispheres, the inner entirely embraced by the outer. The outer (fig. 4, *e*), which is in contact with the inner surface of the gonangium walls, is composed of radiating filaments, each of which under a sufficiently high power of the microscope may be resolved into a linear series of spherical corpuscles. The structure of the inner hemisphere (*d*) which lies in contact with the membranous envelope of the gonophore is more obscure, but would seem to consist of a plasmatic mass containing irregularly disposed nucleus-like corpuscles. The double cap which thus lies upon the summit of the gonophore in the young gonangium gradually atrophies as the gonophore advances towards maturity, and ultimately disappears (fig. 5) or leaves behind only a few radiating irregular threads as evidence of its former existence.

Diplocyathus, n. gen.

Name from διπλόος, double, and κύαθος, a cup, in allusion to the accessory cup at the base of the hydrotheca.

Generic Character. Trophosome.—Hydrocaulus a branching stem on which the hydrothecæ are replaced by hydrophores, each having a small cup of a different form at its base.

Gonosome not known.

This remarkable genus has strong affinities with *Halecium*, from which it differs in the presence of a second cup-like receptacle at the base of every hydrophore. This receptacle is probably a true sarcotheca, and *Diplocyathus* would thus afford an additional instance of the presence of such bodies in Hydroids not belonging to the Plumularinæ.

It is impossible, however, to avoid a comparison of the accessory cup and its contents with the "tentaculoid organs" described by Hincks in *Ophioides*,[1] another genus having close affinities with *Halecium*. An examination of living specimens can alone afford

[1] *Ann. and Mag. Nat. Hist.*, ser. 3, vol. xviii. p. 421, pl. xiv., 1886; British Hydroid Zoophytes, p. 230, pl. xiv.

the means of determining with certainty the nature of the soft parts which fill the little accessory cups of *Diplocyathus;* and the most that could be made out from an examination of the preserved specimens was the presence within the cups of simple granular contents, which might occasionally be seen to extend beyond the margin, thus suggesting the commencement of a pseudopodial protrusion of the sarcode contents. In other respects the agreement between *Ophioides* and *Diplocyathus* is so decided that the close affinity of the two genera can hardly be questioned.

The hydrophore in *Diplocyathus dichotomus*, the only known representative of the genus, is funnel-shaped, with a well-developed limbus, a form which closely resembles that of the hydrophore in *Ophioides mirabilis.* In *Ophioides* as figured by Hincks the hydrophores terminate the branches, while in *Diplocyathus* they are disposed alternately from distance to distance along their sides.

Diplocyathus dichotomus, n. sp. (Pl. VIII. figs. 1, 2, 3).

Trophosome.—Hydrocaulus monosiphonic, dichotomously and profusely branched; branches given off in various planes and frequently reuniting with one another so as to form a bulky reticulated mass. Hydrophores widely funnel-shaped, rather closely set, alternate, supported through the medium of a very short annular segment on a lateral process of the stem. Accessory cups cylindrical, sessile, each seated in the axil of the lateral process.

Gonosome not present.

Locality.—Off Somerset, Cape York, Torres Strait; depth, 8 to 12 fathoms.

In its general physiognomy *Diplocyathus dichotomus* is so distinct as to be easily recognised at a glance. It is of remarkably rigid habit, and by the profusion of its branches, which extend in all directions, and their frequent union with one another, it forms a bulky reticulated mass which forcibly recalls the skeletons of some of the horny sponges.

The ramification is regularly dichotomous, and the branches are here and there—but not at exactly regular intervals—intersected by transverse joints. The hydrophores with their accessory cups are borne along the sides of the branches in two very regular alternate series. Their limbus is well developed, but though the cup it forms is deeper than in any of the species of *Halecium*, the hydranth even in its condition of extreme retraction is quite incapable of being included within it, as the soft parts still well preserved in the specimens plainly show. In no instance were the hydrophores in the specimen continued by the superposition of accessory tubes.

The accessory cups, which are situated on the distal side of each of the lateral processes and in the re-entrant angle between this process and the stem, are cylindrical in shape.

Their height is about half that of the hydrophore and their width is about one-third of their height. The orifice is quite even. They are attached to the stem by a narrow continuation of the base, which however is never so elongated as to form a true peduncle.

The Challenger specimen has a height of about four inches. The ramuli which are given off from the main stem are sometimes simple, sometimes once or twice branched.

Among the characters which indicate the close affinity of *Diplocyathus* with *Halecium* must further be mentioned the wreath of minute brilliant points which surrounds the limbus of the hydrophore. Judging from Hincks' figure of *Ophioides* a similar feature would seem to be present in that genus, and indeed is scarcely ever wanting in any species of *Halecium* or of the allied genera.

The hydranth is large and furnished with about twenty-six tentacles.

Family CAMPANULARIDÆ.

Character of the Family. *Trophosome.*—Hydrothecæ borne by peduncles, campanulate or tubular; hydrocaulus not enveloped by peripheral tubes.

Gonosome.—Gonophores planoblasts or hedrioblasts.

Campanularia, Lamarck (*in part*).

Campanularia, Lamarck, Hist. Anim. sans Vert., ed. 2, vol. ii.

Generic Character. *Trophosome.*—Hydrothecæ pedunculate, campanuliform, with serrate or entire margin destitute of operculum, and with the cavity distinctly differentiated by a perforated diaphragm from that of the peduncle, peduncle springing from the sides of a simple or ramified, free or adherent hydrocaulus. Hydranths with a trumpet-shaped hypostome.

Gonosome.—Gonophores adelocodonic, never issuing from beneath the cover of the gonangium.

The genus *Campanularia*, as originally defined by Lamarck, included several forms which the closer examination to which they have been since subjected has shown to be more correctly distributed under separate generic groups. Even among those species in which the hydrothecæ present the true campanulate form, there are some in which the gonophores are sedentary sacs without any obvious medusiform conformation, and others in which the gonophores are true medusiform planoblasts.

A difference of this kind is of sufficient importance to justify its being made the grounds of a generic separation, and I believe with Mr. Hincks that it will be better to limit the genus *Campanularia* so as to make it include only those species in which, with the trophosome presenting the characters here enumerated, the gonophores are destitute of obvious medusiform structure. So limited, it will include the greater number of the species

with true campanulate and pedunculate hydrothecæ, and will leave the remainder of those which would have come under Lamarck's definition to find their places in other genera.

It is unfortunate, however, that the trophosome seldom presents any character which would enable us to assert that its gonophores are hedrioblasts rather than planoblasts, and since in many of the species obtained by the Challenger the gonosome is entirely absent, we are forced to regard the allocation of these species to definite genera as possessing only a provisional validity, liable to be set aside on the discovery of the gonosome.

Campanularia insignis, n. sp. (Pl. IX. figs. 1, 2).

Trophosome.—Colony attaining a height of six inches; stem monosiphonic, clustered, springing from a creeping tubular fibre, regularly set with pinnately disposed alternate ramuli, but otherwise simple or very sparingly branched, both stem and ramuli divided into internodes by equidistant transverse joints. Hydrothecæ borne both by stem and ramuli in two alternate series, every internode supporting a hydrotheca on a point close to its distal end; hydrothecæ deep, cylindrical for some distance from the orifice, and then gradually narrowing into a short peduncle which is borne through the medium of a very short annular segment on the summit of a lateral process of the internode; margin perfectly entire and surrounded by a narrow band.

Gonosome not present.

Locality.—Off Bermudas; depth, 30 fathoms.

Campanularia insignis is a large and handsome species. The long, almost always undivided stems spring from the hydrorhizal plexus in clusters of five or six, and carry along nearly their entire length alternately disposed pinnæ. Every pinna carries two opposite series of alternate hydrothecæ, and two exactly similar series are carried by the stem.

The walls of the hydrotheca are towards the base slightly more convex on the side which is turned away from the internode than on that which faces it, and the perforated diaphragm which forms the floor of the hydrotheca and separates its true cavity from that of the peduncle is oblique. The peduncle joins the supporting process of the internode through the medium of a very short annular segment.

Campanularia insignis comes very near to one of the Gulf Stream Hydroida which, under the name of *Obelia marginata*, was in the absence of the gonosome referred provisionally to the genus *Obelia*. It differs, however, from that species in the shape of the hydrothecæ, which in the Gulf Stream species have rather the form of an inverted cone caused by the gradual diminution of the diameter towards the base; while a further difference is found in the interposition in *Campanularia insignis* of a short annular segment between the peduncle of the hydrotheca and its supporting internode.

No trace of gonosome was present in any of the specimens of *Campanularia insignis*, and our ignorance of this part of the colony gives a purely provisional value to our generic allocation of the species.

Campanularia tulipifera, n. sp. (Pl. X. figs. 1, 1*a*, 1*b*).

Trophosome.—Hydrocaulus attaining a height of about one inch, monosiphonic, sparingly branched. Hydrothecæ supported on peduncles which spring from the sides of the branches with, for the most part, a pinnate and alternate disposition, large, deep, slightly narrowed behind the orifice, and again widening towards the base; margin with wide and shallow crenations, walls with very regular longitudinal plicæ which extend from the orifice to the base, and correspond in number with the marginal crenations.

Gonosome not known.

Locality.—Station 150, off Heard Island; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms.

Campanularia tulipifera is a beautiful little Hydroid, remarkable for the large size and graceful form of its hydrothecæ. These are three-twentieths of an inch long, and nearly one-twentieth of an inch wide at a point a little above the base. The margin of the orifice is slightly everted, and is indented with eight shallow crenations, from each of which a narrow longitudinal fold of the delicate, perfectly transparent walls passes backwards to the base, thus giving to the hydrothecæ an aspect of extreme elegance which bears a resemblance not very remote to that of the flower of a tulip. The peduncles vary in height but have usually about half that of the hydrothecæ, and are for the most part provided with a distinct joint which is situated near the middle point of their length. The stem though thick is monosiphonic and springs from a creeping tubular filament.

The walls of the hydrothecæ are extremely thin and absolutely transparent, and the plicæ with which they are ornamented are most obvious when the specimen has been just removed from the preserving liquid, and before it is allowed to become dry.

Campanularia ptychocyathus, n. sp. (Pl. X. figs. 2, 2*a*).

Trophosome.—Hydrocaulus a creeping stolon sending off at short intervals the peduncles of the hydrothecæ. Hydrothecæ obconical, deep, with the margin deeply dentate and with the walls for some distance below the orifice very thin and collapsible; peduncles long, annulated at intervals.

Gonosome.—Gonangia borne by the creeping stolon, destitute of annulation, deep, cylindrical, but narrowing towards the base where they are supported on a short annulated peduncle, and with a constriction just below the wide truncated summit; orifice wide, circular, occupying the summit of the gonangium.

Locality.—Bahia.

Campanularia ptychocyathus is a minute creeping form and is rendered specially remarkable by the difference of texture in the walls of the hydrothecæ. These for about the distal third of their height become so thin and collapsible that during the retracted state of the hydranth they are generally seen to have fallen towards one another and become thrown into irregular plicæ which obscure the true form of the hydrotheca, withdrawing from view its regularly dentate margin, a condition, however, which must not be confounded with that of the opercular segments which crown the hydrothecæ in *Campanulina* and some allied forms. The proximal two-thirds of the hydrothecæ possess on the contrary the usual firmness of these parts, and the hydrotheca here retains at all times its true form. The peduncle presents two or three annulations just below the hydrotheca, and several at its origin from the stolon, while a group of rings near the middle of its length is also generally present.

The gonangia are developed from the creeping stolon between the peduncles of the hydrothecæ. They are rendered striking by their nearly cylindrical form, and the constriction which exists immediately below the broad truncated summit. On one or two occasions gonangia were found springing from the peduncle of the hydrotheca.

The gonangia in the specimen are those of a female colony.

Campanularia retroflexa, n. sp. (Pl. XI. figs. 1, 1*a*).

Trophosome.—Hydrocaulus a creeping, filiform, reticulated stolon from which the peduncles of the hydrothecæ are sent off at short intervals. Hydrothecæ deep, cylindrical, with the margin divided into about fourteen blunt teeth and abruptly everted. Peduncles either quite continuous or divided by transverse joints into long clavate internodes.

Gonosome not known.

Locality.—Honolulu; depth, 20 to 40 fathoms.

The abruptly everted margin of the deep cylindrical hydrothecæ gives to this little *Campanularian*, which attains a height of about two-tenths of an inch, a well-marked character. The margin is everted in a plane at right angles to the axis of the hydrotheca, and the teeth into which the rim is divided stand up from it parallel to the axis, thus suggesting the form of the escapement-wheel of a watch.

The peduncles of the hydrothecæ are in most instances intersected by rather distant constrictions, and thus divided into a series of segments. Each of these has a somewhat clavate form, being slightly thicker at its distal than at its proximal end. This condition, however, notwithstanding its rather striking character, is not universally present, some of the peduncles being of uniform thickness and destitute throughout of constrictions.

The specimen occurs growing over the surface of a Millepore.

Campanularia cheloniæ, n. sp. (Pl. XI. figs. 2, 2*a*).

Trophosome.—Hydrocaulus minute; main stems springing at short intervals from a creeping stolon, and sending off from opposite sides alternate, rather distant ramuli, some of which send off secondary ramuli; ramuli distinctly and regularly annulated either in their entire length or at their proximal and distal ends; main stem similarly annulated just above the origin of every ramulus. Hydrothecæ terminating the ramuli obconical, with even margin.

Gonosome not present.

Locality.—Found attached to the back of a Turtle, locality not recorded.

This very minute, delicate, and graceful little species attains a height of about two-tenths of an inch, and is rendered remarkable by the deep, regular, and elegant annulation which occurs in its perfectly transparent chitinous perisarc at definite parts of the stem and ramuli. This annulation sometimes extends from the hydrotheca along the whole length of the supporting ramulus, while sometimes it occurs only at the distal and proximal ends of the ramuli, leaving a space free from annulation towards the middle. The main stem presents a group of similar annulations just above the points from which the ramuli are emitted. Many of the hydranths were well preserved in the specimen.

Obelia, Péron and Lesueur.

Obelia, Péron and Lesueur (the planoblast only), Char. gen. et sp. de Méduses, Ann. du Museum, t. xiv. p. 355, 1809.

Generic Character. Trophosome.—Hydrocaulus simple or branched, fascicled or monosiphonic. Hydrothecæ campanuliform, destitute of operculum, pedunculate, with the cavity distinctly differentiated from that of the peduncle.

Gonosome.—Gonophores medusiform vesiculate planoblasts with shallow umbrella, four radial canals on which the gonads are developed, short manubrium with four-lobed mouth, numerous rather rigid marginal tentacles whose roots are plunged into the substance of the umbrella, otocysts carried each close to the base of a tentacle, velum rudimental.

The most important diagnostic characters of *Obelia* are found in its gonosome. The trophosome agrees in its essential features with that of other Campanularian Hydroids,—whether their gonophores be planoblasts or hedrioblasts—but the planoblasts of *Obelia* present characters so well marked as to render it impossible to confound these with the planoblasts of any other genus.

Among these characters must be specially noted the shallow, almost discoid umbrella, the rudimental velum, the prolongation of the basal portion of the rather rigid marginal

tentacles into the substance of the umbrella, and the close approximation of every otocyst with the base of a tentacle.

Among the Hydroids of the Challenger one species of *Obelia* (*Obelia geniculata*), a very common European form, has been identified.

Obelia geniculata, Linnæus, sp. (Pl. XII. figs. 1, 1*a*).

Sertularia geniculata, Linn., Syst. Nat., 1312.
Laomedea geniculata, Lamx., Cor. flex., 205.
Eucope diaphana, Agassiz, Nat. Hist. of U.S., vol. iv. p. 322, pl. xxxiv. figs. 1–9.
Obelia geniculata, Allman, Ann. and Mag. Nat. Hist., May 1864.
„ „ Hincks, Brit. Hydroid Zooph., p. 149, pl. xxv.

Trophosome.—Hydrocaulus consisting of simple or sparingly branched stems, which arise from a network of creeping fibres, and attain a height of about an inch. Hydrothecæ obconical, with entire margin, alternate, supported each on a strongly annulated peduncle, which springs from a projecting hook-shaped process of the stem situated immediately below the salient angle of every geniculation, and supported by a bracket-like thickening of the chitinous perisarc.

Gonosome.—Gonangia borne on short annulated peduncles which spring from the angles between the hydrothecæ and the stem, urn-shaped, gradually widening from below upwards and terminating distally in a short conical neck, which carries the orifice on its summit.

Locality.—Kerguelen Island; depth, 20 to 26 fathoms.

Station 315, Port William, Falkland Islands; lat. 51° 40′ S., long. 57° 50′ W.; depth, 5 to 12 fathoms.

Among the whole of the Campanularian Hydroids there is perhaps not one in which the characters of the trophosome are so definite and so easily recognisable as in *Obelia geniculata*. The remarkable development of the chitinous perisarc which occurs on one side of every internode, and supports the alternately disposed hydrothecæ in the manner of a bracket, has not been found in any other species.

Obelia geniculata is one of the few British Hydroids obtained by the Challenger. In the British and European seas it is one of the commonest and most widely distributed species, while it has also been obtained on the eastern and western shores of the United States, and on the coast of Labrador (Hincks), as well as in the seas round the North Cape.

The Challenger dredged it from two localities, one in the region of Kerguelen Island, and the other in that of the Falkland Islands. Both therefore in nearly the same southern latitudes, though separated by about 130° of longitude. The distance between these extreme southern localities and the Arctic Ocean in which it has been found by Sars, affords one of the most striking examples known of the wide geographical distribution of a single species.

The internodes of the stem in the southern form are perhaps slightly longer and more slender than those of the northern, but no difference can be found which would justify the specific separation of the two forms.

The soft parts of the trophosome were well preserved in the specimens.

Thyroscyphus, Allman.

Thyroscyphus, Allman, Hydroids of the Gulf Stream, p. 10.

Generic Character. *Trophosome.*—Hydrocaulus composed of consecutive internodes, each supporting a pedunculate hydrotheca. Hydrothecæ with the cavity divided from that of the peduncle by a perforated diaphragm, and having the orifice surmounted by a roof which is composed of four triangular membranous valves.

Gonosome not known.

The genus *Thyroscyphus* was formed for a Hydroid dredged off Sand Key, from a depth of 10 fathoms, during the United States' exploration of the Gulf Stream. The species which compose it differ from the other operculate forms of the Campanularinæ in the operculum of its campanuliform hydrothecæ consisting of exactly four valves well differentiated from the walls of the hydrotheca, instead of the much greater and indeed indefinite number of segments which in others crown the hydrotheca, or into which the margin of the hydrotheca in these is cleft; and in the fact of the hydrocaulus being composed of a succession of distinct internodes, each with its pedunculate hydrotheca.

Thyroscyphus ramosus, Allman (Pl. XII. figs. 2, 2*a*).

Thyroscyphus ramosus, Allman, Hydroids of the Gulf Stream, p. 11, pl. vi. figs. 5, 6.

Trophosome.—Hydrocaulus monosiphonic, consisting of a main stem set with pinnately disposed, alternate, simple or branched ramuli. Hydrothecæ borne both by main stem and ramuli, distichous and alternate, large and deep, cylindrical towards the summit, but gibbous below on the side which faces the internode; peduncle short, composed of two oblique, annular segments.

Gonosome not known.

Locality.—Bahia.

Though the present Hydroid differs to some extent in habit from *Thyroscyphus ramosus* of the collections obtained by the United States' exploration of the Gulf Stream, I have no hesitation in regarding it as specifically identical with that form.

The Challenger specimen has a height of about four inches. The ramuli which are given off from the main stem are sometimes simple, sometimes once or twice branched. The peduncles of the hydrothecæ always spring from a point close to the distal end of an internode, where they are supported on the summit of a short, thick, lateral process of the

internode, and the extreme rim of the hydrotheca is surrounded by a narrow band of a colour somewhat lighter than that of the rest of the walls. The main stem has a thickness which is about twice that of the ramuli, and is divided into internodes, each carrying a hydrotheca on alternate sides exactly as in the ramuli.

The ramuli are given off from the main stem, each close to the point from which the peduncle of a hydrotheca springs. In the more proximal portion of the stem they all lie in one and the same plane with the hydrothecæ, but towards the distal parts they frequently, immediately after their origin, take different directions, and have thus, though all simply distichous at their origin, the appearance of being irregularly scattered.

Thyroscyphus simplex, n. sp. (Pl. XIII. figs. 1, 2).

Trophosome.—Colony attaining a height of nearly six inches; stems monosiphonic, clustered unbranched, and carrying along nearly their entire height pinnately disposed alternate ramuli. Hydrothecæ borne both by main stem and ramuli, deep, cylindrical, terminating below in a short unjointed peduncle, which is supported directly on the summit of a stout lateral process of the internode.

Gonosome not known.

Locality.—Off Somerset, Cape York, Torres Strait; depth, 8 to 12 fathoms.

Thyroscyphus simplex occurs in clusters of three or four erect simple stems which spring from a common creeping tubular fibre, and are regularly set throughout with alternate pinnæ, which towards the middle of the stems attain a length of nearly an inch. Every internode of stem and pinnæ carries close to its distal end, and on alternate sides, a short lateral process which directly supports the short peduncle of the hydrotheca. The hydrotheca at its base loses its exactly symmetrical outline and becomes slightly gibbous on the side which is turned towards the internode, and here an oblique diaphragm forms the boundary between its cavity and that of the peduncle. The four valves with which the hydrotheca is crowned are very thin and membranous, and form when in apposition a beautiful pyramidal roof. There is no marginal band.

In habit and general physiognomy *Thyroscyphus simplex* so closely resembles *Companularia insignis* that a careful examination is needed in order to distinguish the two forms.

Hypanthea, Allman.

Hypanthea, Allman, Report on the Collections made by the Transit of Venus Expedition to Kerguelen Island, Phil. Trans., 1879, vol. clxviii. p. 284.

Generic Character. Trophosome.—Hydrothecæ borne each on the summit of a cylindrical peduncle, which springs from a creeping stolon, inoperculate, with the

cavity so reduced by the great thickness of its chitinous walls as to be incapable of receiving the hydranth in retraction.

Gonosome.—Gonophores in the form of simple sporosacs developed within chitinous gonangia, which spring, aggregated or scattered, from the creeping stolon.

The genus *Hypanthea* was founded for a Calyptoblastic Hydroid brought home from Kerguelen Island by the section of the Transit of Venus Expedition whose observations were carried on in that island.

The species obtained by the Transit Expedition is distinct from that dredged by the Challenger off the same island, and differs still more widely from another species of the same genus obtained by the Challenger off the Falkland Islands.

The genus is very remarkable, the place of the hydrothecæ being taken by bodies which differ from proper hydrothecæ in having the cavity so reduced by the great thickness of the chitinous walls, that they may be said to support rather than contain the hydranths, which are thus nearly as much unprotected as the hydranths in *Halecium*, where the hydrothecæ remain in a condition quite rudimental.

Hypanthea aggregata, n. sp. (Pl. XIV. figs. 1, 1*a*).

Trophosome.—Hyrocaulus a creeping and reticulated stolon, from which are emitted scattered simple peduncles; peduncles about a quarter of an inch in height, cylindrical, smooth, with a swollen summit which, through the intervention of a single globular segment, supports the hydrotheca. Hydrothecæ obconical, compressed, with oblique entire margin.

Gonosome.—Gonangia (female) springing like the peduncles of the hydrothecæ from the creeping stolon, densely crowded, fusiform, each tapering below to its point of attachment without forming a definite peduncle, and terminating distally in a laterally compressed orifice.

Locality.—Kerguelen Island; depth, 20 to 26 fathoms.

The present species differs from *Hypanthea repens* of the Transit of Venus Expedition in its densely aggregated instead of scattered gonangia. These form in *Hypanthea aggregata* a densely crowded mass, and the hydrostyles, instead of arising in the intervals of the gonangia, spring separately from the stolon. The gonangia in the Challenger specimen are exclusively such as contain female sporosacs, thus again differing from those of *Hypanthea repens*, in which it would appear that the colony may be monœcious, male and female gonangia being there associated on the same stolon.

The cavity of the hydrotheca is represented by a comparatively shallow saucer-like depression, prolonged by a narrow canal which extends downwards nearly in the axis of

the hydrotheca to its base, where it is slightly dilated and then becomes continuous with the canal of the peduncle.

The chitinous walls of the hydrotheca are enormously thickened, and in their thickness so far encroach on the cavity as to reduce this to the condition of the saucer-like depression with its tubular prolongation. Towards the free margin of this depression the walls thin away, and here terminate in a comparatively thin edge.

The hydrotheca is remarkable for its want of symmetry; for not only is its summit truncated obliquely, but the walls on one side are much thicker than on the other, and the cavity is thus thrown out of the axis. The hydrotheca is laterally compressed, and it is when viewed from its broad side that the departure from symmetry is apparent. When the narrower side is turned towards the observer the hydrotheca appears quite symmetrical. Between the hydrotheca and the summit of the peduncle there exists a short, nearly globular segment, and this, with the hydrotheca which it carries, may be depressed laterally on the peduncle.

The body of the hydranth rests in the saucer-like depression on the summit of the hydrotheca, and is extended through the canal as a cylindrical tube, in order to become continuous with the cœnosarc of the peduncle. Though the hydranths were imperfectly preserved in the specimen it was evident that for some distance from their oral end they lay permanently outside of the hydrotheca, and that the oral disc with its circlet of tentacles was, even in the state of extreme retraction, entirely exposed.

The gonangia are fusiform capsules attaining a height equal to about half that of the peduncles of the hydrothecæ, and contain each a single sporosac which forms an elongated oval sac springing from the side of the blastostyle near its base, and containing numerous ova. Immediately above the point from which the sporosac arises the blastostyle breaks up into a network of tubes by which the sporosac is surrounded, and which unite in the plug-like operculum which occupies the summit of the gonangium.

The excessive development of the chitinous perisarc is not confined to the hydrotheca, but shows itself in the peduncles, in the gonangia, and in the reticulated stolon, all which parts are remarkable for the great thickness of their walls. The perisarc is further remarkable for its density and transparency.

Hypanthea aggregata was found spreading over the fronds of a Laminaria-like sea-weed.

Hypanthea hemispherica, n. sp. (Pl. XIV. figs. 2, 2*a*).

Trophosome.—Hydrocaulus a creeping, sparingly branched stolon, which gives off both peduncles and gonangia at intervals along its length; peduncles varying in length from one-twentieth to one-tenth of an inch, cylindrical and smooth, with the distal end

slightly swollen, and carrying the hydrotheca through the medium of a small globular segment. Hydrothecæ hemispherical with oblique margin.

Gonosome.—Gonangia elongate ovate, with slightly expanded and truncated summit, smooth, supported on very short but definite peduncles which spring from the creeping stolon in the intervals of the hydrothecal peduncles never clustered.

Locality.—Station 315, Port William, Falkland Islands; lat. 51° 40′ S., long. 57° 50′ W.; depth, 5 to 12 fathoms.

The present species is very distinct from both *Hypanthea repens* and *Hypanthea aggregata*. It is a much smaller form than either of these, while the hydrothecæ are much shorter and relatively wider than those of either of the Kerguelen species. The gonangia, moreover, instead of being fusiform as in these, widen at the summit, and instead of forming dense groups as in *Hypanthea aggregata*, are distributed along with the hydrothecæ singly over the length of the stolon. Where the gonangia are present there is usually one between every two hydrothecæ.

Hypanthea hemispherica, like the other two described species, spreads over the fronds of a Laminaria-like seaweed. While both the former are inhabitants of the seas off Kerguelen Island, the present species was dredged off the Falkland Islands. Though the two localities agree pretty closely in latitude they differ widely in longitude, and the fact of so remarkable a genus being represented—though by different species—in both, points to an interesting parallelism between the faunæ of the two regions. A still further feature of parallelism is seen in the occurrence of *Obelia geniculata* both in the region of Kerguelen and in that of the Falkland Islands.

Calamphora, n. gen.

Name from καλὸς, beautiful, and ἀμφορεὺς, a pitcher, in allusion to the form of the hydrothecæ.

Generic Character. Trophosome.—Hydrocaulus a creeping stolon. Hydrothecæ lageniform, inoperculate, almost sessile on the stolon.

Gonosome.—Gonangia oviform, subsessile on the stolon.

The genus *Calamphora* differs from all the other Campanularians in the form of its hydrothecæ, which are neither campanulate as in *Campanularia* and its more immediate allies, nor tubiform as in *Callicella*, *Lafoëa*, &c. They are on the contrary wide and ventricose towards the middle and contracted at both distal and proximal ends.

The hydrotheca is provided at its proximal end with a diaphragm or floor perforated for the transmission of the cœnosarc which is to become developed into a hydranth in the cavity of the hydrotheca. In this respect the present genus agrees with *Campanularia* but differs from most of the species in which the hydrotheca departs from the campanulate type of form, for in these the cavity of the hydrotheca is directly continuous with that of the peduncle or with that of the common stem.

Calamphora parvula, n. sp. (Pl. X. figs. 3, 3*a*).

Trophosome.—Hydrocaulus a narrow, creeping, adherent tube, to which the hydrothecæ are attached at short intervals by very short, almost evanescent, peduncles. Hydrothecæ with very regular closely set annular ridges, and contracted distally into a short neck which terminates in a tetragonal orifice, and is directed towards one side so as to form an obtuse angle with the axis of the hydrotheca.

Gonosome.—Gonangia oviform, considerably larger than the hydrothecæ, regularly and distinctly annulated throughout, subsessile on the creeping tube from which each springs close to the origin of a hydrotheca, and opening on the summit by a circular four-toothed orifice.

Locality.—Station 162, off East Moncœur Island, Bass Strait; depth, 38 fathoms.

This beautiful little species, which scarcely attains a height of one-fortieth of an inch, occurred in abundance creeping over specimens of *Dictyocladium dichotomum.* The hydrothecæ are rendered bilateral by the direction of the neck towards one side, while the tetragonal orifice and regular annulation of their walls contribute still further to the singularity and elegance of their form. This distinct annulation of the walls of the hydrothecæ, as distinguished from mere striæ indicative of successive elongations in growth, is indeed a character in the highest degree exceptional among the Campanularians. An instance of it occurs in *Hebella striata*, one of the species dredged by the Challenger, and in *Lafoëa* (*Hebella*) *venusta*, a species obtained during the United States' exploration of the Gulf Stream. In *Hebella striata*, however, the annulation is very much more delicate than in *Calamphora parvula.* The gonangium in *Calamphora parvula* is also annulated in a manner quite similar to that of the hydrothecæ. The annulation of the gonangium, however, is of frequent occurrence among the Campanularian and Sertularian Hydroids.

Hebella, n. gen.

Name from Hebe, the cup-bearer of classical mythology.

Generic Character. Trophosome.—Hydrocaulus a creeping monosiphonic stolon. Hydrothecæ cylindrical, with entire margin, destitute of operculum, and with the cavity distinctly differentiated from that of the peduncle.

Gonosome not known.

The genus *Hebella* includes a number of minute Hydroids with cylindrical cup-shaped hydrothecæ. Most of these have been arranged by Hincks under the genus *Lafoëa.* From this genus, however, as here limited, they differ in their monosiphonic hydrocaulus, and in the distinct differentiation of the hydrothecal cavity from the cavity of the peduncle. From *Campanularia* and its immediate allies *Hebella* is distinguished by

the cylindrical form of its hydrothecæ. Our knowledge of the group, however, is still imperfect, for not only are we entirely ignorant of the gonosome, but even the true form of the hydranth is imperfectly known to us. It is probable, however, that this, like the hydranth of *Lafoëa* and the allied genera, is provided with a conical hypostome, instead of having the hypostome, as in *Campanularia* and its allies, trumpet-shaped.

The Challenger collection contains one beautiful representative of the genus *Hebella*.

Hebella striata, n. sp. (Pl. XV. figs. 3, 3*a*).

Trophosome.—Hydrocaulus a creeping monosiphonic stolon giving off the hydrothecæ from distance to distance along its length. Hydrothecæ large, cylindrical, marked by very delicate, closely set, annular striæ, contracted below into a peduncle of variable length.

Gonosome not known.

Locality.—Station 312, Port Famine, Magellan Strait; lat. 53° 38′ S., long. 70° 56′ W.; depth, 10 to 15 fathoms.

Hebella striata is a beautiful little Hydroid. Its relatively large hydrothecæ are borne at intervals along a creeping stolon. They are cylindrical through nearly their entire height, and then gradually taper into a peduncle which varies much in length. They are deep and relatively wide, and with the margin for the most part very slightly everted. Occasionally they present a decided curvature of the axis. Their walls are perfectly transparent, and marked by an exceedingly delicate sculpture of fine, closely set, annular striæ, rendering them, when viewed with a good illumination under a moderate power of the microscope, objects of extreme beauty. Though the hydranth was fairly well preserved in the specimen the form of the hypostome could not be determined.

The specimens occur creeping over the fascicled stems of *Lafoëa fruticosa*.

Halisiphonia, n. gen.

Name from ἅλς, sea, and σίφων, a tube, in allusion to the tubular form of the hydrothecæ.

Generic Character. Trophosome.—Hydrocaulus a monosiphonic stolon. Hydrothecæ tubiform, with entire margin, destitute of operculum, with the cavity directly continuous with that of the peduncle or stolon, and with the hydrothecal walls never adnate to the hydrocaulus. Hydranth with conical hypostome.

Gonosome.—Gonangial capsules borne by the hydrocaulus.

The genus *Halisiphonia* is constituted for certain Campanularian Hydroids which would find their place in *Lafoëa* as defined by Mr. Hincks. Since the publication, however, of Mr. Hincks's classical work on the British Hydroid Zoophytes, our knowledge of the species which he would bring together under that genus has been increased to such an

extent as to render necessary a revision of the group by a more stringent limitation of *Lafoëa*. See below, p. 32.

The genus *Halisiphonia* is represented in the Challenger collection by a single species, which presents many points of special interest.

Halisiphonia megalotheca, n. sp. (Pl. XVI. figs. 1, 1*a*).

Trophosome.—Hydrocaulus a creeping and adherent tube which supports at irregular intervals pedunculated hydrothecæ. Hydrothecæ very large, cylindrical, gradually passing below into the long, smooth, cylindrical peduncle.

Gonosome.—Gonangia spatuliform, borne on short peduncles and with the summit opening by a long, narrow, transverse slit.

Locality.—Station 160, south of Australia; lat. 42° 42′ S., long. 134° 10′ E.; depth, 2600 fathoms.

The very long tubular hydrothecæ gradually passing into their long peduncles confer on this remarkable species an aspect as striking as it is distinctive. The hydrothecæ measure about one-tenth of an inch in length, and are borne on peduncles whose length is for the most part nearly the same. The creeping stolon from which they spring twines in irregular contortions round the body to which it has attached itself. The deep cylindrical hydrotheca begins, at about three-fourths of its height from the margin, to taper into the peduncle, with the cavity of which its own is uninterruptedly continuous, so that it is not easy to say where the one ends and the other begins.

The gonangia are, like the hydrothecæ, borne by the creeping stolon-like hydrocaulus. Their form is remarkable. They are much compressed, so as to present a spatuliform shape, widening upwards, and gradually narrowing into a short peduncle below. They are widest at the summit, where they terminate in a sharp edge. Along this edge the walls of the gonangium admit of being separated from one another so as to bring into view a narrow slit through which the contents of the gonangium may be liberated. The appearance, indeed, of the gonangium with its slit-like opening is such as to suggest rather forcibly that of a flat bivalve shell, or the ovarian nidus of certain Gasteropodous Mollusca. Nothing can be asserted of its contents, which had in every case disappeared.

The collection contains but a single and somewhat fragmentary specimen, which twined round a portion of a fascicled stem, probably that of *Cryptolaria abyssicola*, a species with which it was associated.

The enormous depth of 2600 fathoms from which both *Halisiphonia megalotheca* and *Cryptolaria abyssicola* were obtained has much significance, in connection with the fact that in both species the gonangia are present, *Halisiphonia megalotheca* affording the only known instance, and *Cryptolaria abyssicola* one of the very few, in which any part of the gonosome has been observed in these genera.

Family PERISIPHONIDÆ.

Character of the Family. *Trophosome* formed of two essential constituents—an axial and a peripheral, the axial consisting of a single tube which carries the hydrothecæ and the peripheral, formed of numerous tubes destitute of hydrothecæ, and united into a fascicle which surrounds the axial to a greater or less extent, and allows the hydrothecæ to project through intervals between its component tubes. Hydrothecæ never adnate by their sides to the axial tube where this is covered by the peripheral. Peripheral and axial tubes not inseparably coalesced.

There is among the Calyptoblastic Hydroids no more natural and distinctly defined family than that of the Perisiphonidæ. The remarkable structure of the trophosome with its axial hydrotheca-bearing tube enveloped by the peripheral fascicle is, except in *Grammaria*, quite unknown in any other group; for this condition must not be confounded with the fasciculation of the stem which occurs in many Plumularinæ and is common in *Halecium*, *Sertularia*, *Thuiaria*, and other genera (see Part I. p. 4), in which the component tubes are not divisible into an axial tube which carries the hydrothecæ and peripheral tubes which are destitute of hydrothecæ. Except in *Cryptolaria* the gonosome of the Perisiphonidæ is entirely unknown.

Four genera, all of which occur among the dredgings of the Challenger, must be assigned to the family Perisiphonidæ. The essential points of difference between these are given in the following scheme :—

PERISIPHONIDÆ.	Axial tube not wholly enveloped by the peripheral. Hydrothecæ sessile or pedunculate, never adnate to the axial tube, and with the cavity directly continuous with that of the stem or peduncle. No sarcothecæ present.	*Lafoëa.*
	Axial tube not wholly enveloped by the peripheral. Hydrothecæ pedunculate, never adnate to the axial tube, and with the cavity distinctly differentiated from that of the peduncle. No sarcothecæ present.	*Lictorella.*
	Axial tube wholly enveloped by the peripheral. Hydrothecæ pedunculate, distichous. Sarcothecæ developed on the stem.	*Perisiphonia.*
	Axial tube not wholly enveloped by the peripheral. Hydrothecæ sessile on the axial tube, to the free portion of which they are more or less adnate; distichous or scattered. No sarcothecæ present.	*Cryptolaria.*

Lafoëa, Lamouroux.

Lafoëa, Lamouroux, Expos. Méthod., 1821.

Generic Character. *Trophosome.*—Hydrocaulus in its main stem and principal branches consisting of a single axial tube, enveloped by numerous peripheral tubes, but

ceasing to be covered by the peripheral tubes towards the distal parts of the colony. Hydrothecæ tubiform, with entire margin, destitute of operculum, sessile or pedunculate, with their walls never adnate to the hydrocaulus, and with the cavity uninterruptedly continued into that of the peduncles or of the parts of the stem from which they directly spring. Hydranths with a conical hypostome.

Gonosome not known.

The genus *Lafoëa* was founded by Lamouroux in 1821, and since then has been more exactly defined by Sars, and further limited by Hincks. Our increased knowledge of the species, however, and the detection of the perisiphonic nature of the fascicled stem, render necessary a still further amendment of the definition, and the diagnosis here given will, I believe, mark out the true limits of the genus.

The most important characters of this diagnosis will be found in the perisiphonic fasciculation of the stem, the complete freedom of the hydrotheca walls from the hydrocaulus, and the uninterrupted continuity of the cavity of the hydrotheca with that of the peduncle, or, where no peduncle is present, with that of the axial tube from which it springs. By this last character among others it is distinguished from such forms as *Campanularia,* in which the cavity of the hydrotheca is differentiated from that of the supporting peduncle by a basal constriction, forming a more or less pronounced perforated diaphragm.

The distal parts of the colony are always free from the peripheral tubes, a character which *Lafoëa* possesses in common with *Cryptolaria.* In *Lafoëa* the hydrothecæ are never adnate to the axial tubes in any part of the colony; in *Cryptolaria* they are so adnate where the axial tube ceases to be covered by the peripheral.

It is a remarkable fact that, notwithstanding the great abundance of some of the species, no trace of the gonosome has as yet been detected in any true *Lafoëa.*

Hincks has united under *Lafoëa* a number of minute Campanularian Hydroids which the definition here given will exclude, not only on account of their non-fascicled stem, but of the distinct differentiation of the cavities of their pedunculated hydrothecæ. Though we know nothing of their gonosome, while our knowledge of them is in other respects also imperfect, we shall I believe be justified in uniting these little cup-bearing species under a separate genus, to which I have assigned the name of *Hebella.* Their separation from *Campanularia* (as limited above, p. 18) may possibly appear arbitrary, but the more cylindrical cup-shaped form of their hydrothecæ contrasts with the campanulate form of *Campanularia,* and in our very imperfect knowledge of the species will justify the provisional allocation here suggested.

A form with tubiform hydrothecæ but with creeping non-fascicled stem is regarded by Hincks as a variety of *Lafoëa dumosa,* Fleming. I am unable to accept this view, for I regard the perisiphonic stem as an essential character of every true *Lafoëa.* I have accordingly united in a separate genus the monosiphonic Campanularians with tubiform

hydrothecæ and non-differentiated hydrotheca-cavity. To this I have assigned the name of *Halisiphonia*. A remarkable example of it is contained in the collection of the Challenger.

The collection contains two species of the genus *Lafoëa* as limited by the diagnosis here given. Notwithstanding some differences of habit, I cannot find grounds for separating them from the *Lafoëa dumosa* and *Lafoëa fruticosa* of the European seas.

Lafoëa dumosa, Fleming, sp. (Pl. XV. figs. 1, 1*a*).

Sertularia dumosa, Fleming, Edin. Phil. Journ., vol. ii. p. 83.
Lafoëa dumosa, Hincks, Brit. Hydroid Zooph., p. 200, pl. xli. fig. 1.

Trophosome.—Hydrocaulus free, slender, irregularly branched, main stem and principal branches becoming monosiphonic distally. Hydrothecæ springing from all sides of the stem and branches, tubular, with the axis curved away from the stem, gradually narrowed towards the base into a short ill-defined peduncle of attachment.

Gonosome not known.

Locality.—Station 25, off Sombrero Island, West Indies; depth, 450 fathoms.

This is a very slender form, of delicate habit, and quite destitute of the vigorous growth by which some of the other species of *Lafoëa* are characterised. The specimen has a height of about two inches. The hydrothecæ are deep and rather wide, but towards the base become gradually narrowed into a short peduncle, which is so imperfectly defined that the hydrothecæ may almost be regarded as sessile. The branches in their monosiphonic portion present here and there a shallow, scarcely recognisable, constriction, but there are no true joints dividing them into internodes.

Apart from its more slender form and delicate habit, the present Hydroid possesses no character which would afford grounds for its separation from *Lafoëa dumosa;* and as these differences seem to lie within the limits of variation of a species, I believe we must regard it as specifically identical with the European form.

Lafoëa fruticosa, Sars (Pl. XVI. figs. 2, 2*a*).

Lafoëa fruticosa, Sars, Bemærk. over fire norske Hydroider, Vidensk. Forhandl., 1862.
Lafoëa fruticosa, Hincks, Brit. Hydroid Zooph., p. 202, pl. xli. fig. 2.

Trophosome.—Stem free, attaining a height of upwards of three inches, profusely branched, branches mostly in one and the same plane, primary branches irregular, closely set with pinnately disposed alternate ramuli, which are themselves for the most part set with secondary pinnæ. Hydrothecæ springing irregularly from all sides of the hydrocaulus, deep and narrow, with the axis gently curved away from the supporting stem, gradually narrowing into a loosely twisted peduncle.

Gonosome not present.

Locality.—Station 312, Port Famine, Magellan Strait; lat. 53° 37′ S., long. 70° 56′ W.; depth, 9 to 15 fathoms.

I cannot find any character which would justify the separation of this beautiful Hydroid from the *Lafoëa fruticosa* of Sars. Its pinnate ramification, lying nearly in one and the same plane, and stretching laterally to an extent which nearly equals that of the height of the colony, gives to the entire assemblage a somewhat flabelliform shape. The stem and principal branches are fascicled on the perisiphonic type, but towards the distal extremities become monosiphonic. The long and narrow hydrothecæ gradually taper towards the base into peduncles which are but slightly narrower than the body of the hydrotheca, from which they are not separated by any definite line of demarcation. The peduncles are not annulated, but present about two turns of a very open spiral.

The soft parts were well preserved in the specimen, and the hydranths could in many instances be seen in sufficient detail to render most of their external characters easily recognisable.

Lictorella, n. gen.

Name suggested by the resemblance of the perisiphonic stem to the bundle of rods carried by the Roman lictor.

Generic Character. Trophosome.—Hydrocaulus consisting of a single axial tube enveloped to a greater or less extent by numerous peripheral tubes but free in its more distal parts. Hydrothecæ cylindrical, pedunculate, with entire margin, destitute of operculum, and with the cavity distinctly differentiated from that of the peduncle, their walls never adnate to the hydrocaulus.

Gonosome not known.

The genus *Lictorella* includes certain Campanularian Hydroids with branching perisiphonic hydrocaulus. Though it approaches *Lafoëa* in its perisiphonic hydrocaulus and in its deep and somewhat tubiform hydrothecæ, the presence of a limiting floor by which the cavity of the hydrotheca is distinctly differentiated from that of the peduncle renders it necessary to keep it generically distinct. Though the hydranth has not yet been observed, the analogy of allied forms renders it probable that the hypostome is conical.

The collection contains two species referable to the genus *Lictorella*.

Lictorella halecioides, Allman (Pl. XVII. figs. 1, 2).

Lafoëa halecioides, Allman, Report on the Hydroida collected during the Expedition of H.M.S. "Porcupine," Trans. Zool. Soc. Lond., vol. viii.

Trophosome.—Hydrocaulus attaining a height of about four inches; perisiphonic stem irregularly branched, stem and branches sending off very regular, pinnately disposed, alternate monosiphonic ramuli, which carry along their entire length two series of alternate

shortly peduncled hydrothecæ. Hydrothecæ borne both by the perisiphonic stem and the monosiphonic ramuli, deep and narrow, with the axis slightly curved away from the supporting ramulus or stem; margin scarcely everted, peduncle formed of two short annular segments.

Gonosome not present.

Locality.—Off Somerset, Cape York, Torres Strait; depth, 8 to 12 fathoms.

The deep narrow hydrothecæ of the present species resemble in form those of a *Lafoëa*, from which, however, they differ in the presence of the limiting diaphragm or floor at the basal end. The ramuli which carry the hydrothecæ in two alternate series are here and there divided into internodes by transverse joints. These occur chiefly towards the distal extremity of the ramulus, where two hydrothecæ usually intervene between two joints. The ramuli are very regularly disposed, forming a series of equidistant alternate pinnæ on each side of the fascicled stem. Those of one side, however, are not placed exactly opposite to the middle points between the pinnæ of the opposite side.

I have little hesitation in regarding the present Hydroid, notwithstanding its more robust habit and somewhat more irregular ramification, as specifically identical with *Lafoëa halecioides* of the "Porcupine" collection, a species which, in accordance with the limitation of *Lafoëa* here insisted on, must be removed from that genus and placed in the genus *Lictorella*, keeping in mind, however, that so long as the gonosome is unknown, no generic allocation can be regarded as otherwise than provisional. The removal from *Lafoëa* is justified by the fact of the hydrothecæ being provided with a definite floor instead of having their cavity, as in the true *Lafoëa*, directly continuous with that of the hydrothecæ.

The specific identification of the Challenger Hydroid with that of the "Porcupine" is not without significance, when we bear in mind the widely separated localities and very different conditions under which the two were found. The specimens brought home by the "Porcupine" were dredged from the cold area which lies between Shetland and the Færöe Islands, and from depths of 640 and 345 fathoms; while those of the Challenger were dredged off Cape York, Torres Strait, from a depth of about 8 fathoms.

Lictorella cyathifera, n. sp. (Pl. XI. figs. 3, 3*a*).

Trophosome.—Hydrocaulus pinnately branched; stem and principal branches perisiphonic, becoming monosiphonic towards their extremities, and sending off very regular, pinnately disposed, alternate monosiphonic ramuli, which are destitute of distinct joints, and carry the pinnately disposed alternate hydrothecæ. Hydrothecæ deeply cyathiform, with an entire and very slightly everted rim, and supported on a very short unjointed peduncle which springs from a short fixed process of the hydrocaulus.

Gonosome not known.

Locality.—Station 177, off the New Hebrides; lat. 16° 45′ S., long. 168° 7′ E.; depth, 63 to 130 fathoms.

Lictorella cyathifera attains a height of about two inches. The main stem is stout and strongly perisiphonic towards the base, the principal branches are similarly perisiphonic, and the whole colony is characterised by a peculiarly rigid habit.

The hydrothecæ, while pinnately disposed and exactly alternate, have their axes slightly directed towards one side of the ramulus. The rim is perfectly circular, even, and very slightly everted.

Most of the hydrothecæ exhibit just behind the rim one or two delicate annular striæ, indicative of successive periods of growth. The hydrothecæ-bearing ramuli present no distinct joints, and thus show no division into internodes.

Lictorella cyathifera comes very near to *Lictorella halecioides* of the present Report, which I have identified with *Lafoëa halecioides* of the "Porcupine" collection.

Lictorella halecioides, however, is altogether a larger and stronger species, while its ultimate ramuli are intersected by distinct though not exactly equidistant joints, and the hydrothecæ are narrower in proportion to their height, and have their peduncles jointed.

The two species, however, undoubtedly come very near to one another, and the wide distribution of a type of form, the variation of which is so slight as to be almost within the limits of mere varietal distinction, is exceedingly interesting. *Lictorella halecioides*, as represented by the examples dredged by the "Porcupine," was obtained from the cold area which lies between Shetland and the Færöe Islands, from depths of 640 and 345 fathoms, with a bottom temperature of 36° F.; the Challenger examples of the same species were dredged off Cape York, Torres Strait, from a depth of from 8 to 12 fathoms; while the station of *Lictorella cyathifera* lies off the New Hebrides, where it was dredged from depths of from 63 to 130 fathoms.

Cryptolaria, Busk.

Cryptolaria, Busk, Quart. Journ. Micr. Sci., ser. 1, vol. v. p. 173, 1857

Generic Character. Trophosome.—Hydrocaulus consisting of two parts, an axial and a peripheral, the peripheral consisting of a fascicle of simple tubes, the axial of a single tube, simple or branched, whose proximal portion lies under cover of the peripheral, and whose distal portion is free. Hydrothecæ borne both by the covered and the free portions of the axial tube, tubiform, destitute of peduncles, with the cavity directly continuous with that of the axial tube, and with their walls never adnate to the axile tube, where this is covered by the peripheral fascicle, but more or less adnate to the tube in the free portion of its course.

Gonosome.—Gonangia consisting of sac-like receptacles, which spring at intervals

from the axial tube and protrude externally through interstices between the tubes of the peripheral fascicle.

The genus *Cryptolaria* was founded by Busk for a group of Calyptoblastic Hydroids, whose fascicled stems and sessile tubular hydrothecæ, destitute of limiting floor, and adnate to the axial tube on its free portion, afford easily recognisable characters.

The specimens obtained by the Challenger have furnished the means of working out in further detail the structure of this curious group, and not only of satisfactorily determining the essential constitution of its trophosome, but of rendering us to some extent acquainted with its gonosome, which had not previously been detected.[1]

The existence of two distinct elements, a peripheral and an axial, in the hydrocaulus of *Cryptolaria* is an important and unexpected character, and with the exception of four other genera, *Lafoëa*, *Lictorella*, *Perisiphonia*, and *Grammaria*, for a knowledge of whose essential structure we are also indebted to the dredgings of the Challenger, *Cryptolaria* is the only genus, so far as is yet known, in which this condition is present.

In all the known species of *Cryptolaria* the peripheral tubes cease to envelop the axial at some distance from the distal extremities of the branches, and the axial tube thus becoming free and naked shows here, without further preparation, the relation between it and the hydrothecæ. The structure of that part of the colony where the axial tube is still covered by the peripheral can be best demonstrated by careful maceration in caustic potash, which diminishes the adhesion between the constituent tubes and facilitates their separation under the microscope.

The gonosome has as yet been found only in three species of *Cryptolaria*. Two of these, *Cryptolaria abyssicola* and *Cryptolaria diffusa*, have been dredged from the vast depths of 2600 and 2500 fathoms respectively, while the third, *Cryptolaria geniculata*, has been brought up from a depth of 315 fathoms. In all these the relation of the gonangia to the axial tube is very similar to that of the hydrothecæ, and like the hydrothecæ, they protrude at intervals from between the component tubes of the peripheral fascicle. They suggest indeed an obvious comparison with the hydrothecæ, from which they differ chiefly in their greater size and more sac-like form. No other element of the gonosome beyond the gonangia has been detected.

The collection of the Challenger is very rich in the species of *Cryptolaria*. These have been obtained from widely separated localities and from various depths, ranging from 20 fathoms to nearly the greatest which have yielded any living forms to the dredge. No species of *Cryptolaria* have as yet been recorded from European seas.

In distinguishing the species for purposes of systematic description the zoologist

[1] In the Report on the Hydroids of the Gulf Stream I described a remarkable structure which was found attached to the stems of a species of *Cryptolaria*, and which I regarded as exhibiting undoubted affinities with the Hydroid genus *Coppinia*, suggesting at the same time the possibility of its turning out to be the gonosome of the *Cryptolaria*, nothing having been at that time known of the gonosome of this genus. It is now evident that the structure in question is an independent growth, having nothing to do with the gonosome of the Hydroid on which it had taken up its abode.

has comparatively little to rely on. Parts which in other Hydroids afford convenient specific characters here present little or no variation. The instances in which the gonosome is known are so few that the use of this for diagnosis is necessarily very limited, while the form of the hydrothecæ is in all the known examples of *Cryptolaria* so much alike, that we can seldom find in it a character of undoubted diagnostic value. In the disposition of the hydrothecæ some sufficiently convenient characters may be found, while beyond this scarcely anything is left for the determination of specific difference but the form of the ramification, and even this varies within very narrow limits.

The species of *Cryptolaria* defined in the present Report have been founded on the characters just indicated, and notwithstanding the paucity of the material available for diagnosis, I believe that they may be accepted as legitimate groups.

Cryptolaria humilis, n. sp. (Pl. XVIII. figs. 1, 1*a*, 1*b*).

Trophosome.—Colony attaining a height of somewhat more than an inch, rooted by a plexus of fine branching filaments; stem sparingly and irregularly branched. Hydrothecæ alternate and distichous.

Gonosome not known.

Locality.—Station 73, near the Azores; lat. 38° 30′ N., long. 31° 14′ W.; depth, 1000 fathoms.

It was from the examination of this little species that I first obtained evidence of the true structure of *Cryptolaria*. By boiling the stem in caustic potash the adhesion of the component tubes with one another can be so weakened that it becomes easy to separate them by means of the dissecting needle. The axial tube with its hydrothecæ will then be brought into view, and its relation to the peripheral tubes will be at once made apparent.

Where the axial tube lies under cover of the peripheral it will be seen that the hydrothecæ spring from it at equal intervals, and that they are alternate and distichous. They are long and tubular, gently curving outwards, cylindrical towards the orifice, and thence tapering gradually to their point of origin from the axial tube, into which they directly open instead of being, as in the allied genus *Perisiphonia*, connected with this tube by the intervention of a definite peduncle.

At a short distance from the distal extremities of the branches the peripheral tubes cease to envelop the axial, which thus becomes naked for the remainder of its course. This condition, so far as is yet known, is universal among the *Cryptolariæ*. In the continuation of the axial tube beyond the peripheral fasciculus, the epicauline wall of the hydrothecæ is to a greater or less extent adherent to the opposed wall of the tube, while in the more proximal parts of the colony where the axial tube lies under cover of the peripheral no adhesion of this kind exists, the walls of hydrothecæ being here quite free from the supporting tube.

The locality from which the present species was obtained is in the neighbourhood of the Azores, where it was dredged from a depth of 1000 fathoms.

Cryptolaria abyssicola, n. sp. (Pl. XVIII. figs. 2, 2*a*).

Trophosome.—Hydrocaulus much and very irregularly branched, branches rather slender, flaccid. Hydrothecæ disposed on all sides of the stem.

Gonosome.—Gonangia springing at intervals along the stem, and forming long, tubular receptacles, ventricose towards the base, and then tapering to their point of attachment, and terminating distally in a truncated summit which is occupied by the wide circular orifice.

Locality.—Station 160, south of Australia; lat. 42° 42′ S., long. 134° 10′ E.; depth, 2600 fathoms.

The vast depth from which *Cryptolaria abyssicola* has been dredged gives it a special interest, which is greatly enhanced by the fact that it affords one of the very few instances as yet known in which the gonosome of *Cryptolaria* has been detected. It was associated with *Halisiphonia megalotheca* (p. 31) brought up in the same haul.

The scattered instead of distichous disposition of the hydrothecæ is a peculiar and exceptional character.

The specimen is only fragmentary, and no exact assertion can be made as to the size which the species may naturally attain. The largest fragments preserved measure about two inches in height.

Cryptolaria flabellum, n. sp. (Pl. XIX. figs. 1, 1*a*).

Trophosome.—Colony attaining a height of about one inch; hydrocaulus rigid, rooted by a thick disc-like expansion, ramification in a single plane, and irregular. Hydrothecæ alternate, distichous, very long and slender.

Gonosome not known.

Locality.—Station 24, off Culebra Island, West Indies; depth, 390 fathoms.

Cryptolaria flabellum is an unusually well-marked form. Its long curved hydrothecæ resemble slender lateral branches, while its rigid habit, and the fact of the ramification being all in one and the same plane, call to mind the general aspect of certain Gorgonian Corals.

Cryptolaria pulchella, n. sp. (Pl. XIX. figs. 2, 2*a*).

Trophosome.—Colony attaining a height of nearly three inches, main stem irregularly branched, branches carrying regular, pinnately disposed, alternate ramuli. Hydrothecæ alternate, very regularly distichous.

Gonosome not known.

Locality.—Honolulu; depth, 20 to 40 fathoms.

The very regularly pinnate disposition of the ramuli, and the absolutely distichous and regular disposition of the hydrothecæ, give to this species an aspect of considerable elegance. It is a strong growing form with rather close-set, stout, and short hydrothecæ.

It is an inhabitant of rather shallow water, having been obtained from a depth of between 20 and 40 fathoms; one of the specimens had adherent to it a species of the Rhizopodous genus *Myriotrema*—a characteristic littoral form.

Cryptolaria crassicaulis, n. sp. (Pl. XIX. figs. 3, 3*a*).

Trophosome.—Colony attaining a height of four inches, profusely and very irregularly branched main stem, and primary branches very thick. Hydrothecæ alternate and distichous.

Gonosome not known.

Locality.—Station 344, off Ascension Island; depth, 420 fathoms.

The present species is remarkable for the profuseness and irregularity of its ramification, and for the great thickness of its stem and principal branches. The ultimate branches on the other hand are slender and flaccid. The hydrothecæ are stout, and the exserted portion rather long. Here and there, and at uncertain intervals, slight constrictions may be noticed in the branches.

Cryptolaria geniculata, n. sp. (Pl. XX. figs. 1, 1*a*, 1*b*).

Trophosome.—Colony attaining a height of three inches or more, irregularly branched, stem and branches rather rigid, very regularly geniculate. Hydrothecæ alternate, distichous, springing from the salient angle of every geniculation; orifice with two membranous valves.

Gonosome.—Gonangia somewhat flask-shaped, each occupying the entire interval between two successive geniculations of the stem, to which it is adnate by nearly the whole of its epicauline side.

Locality.—Station 173, off Matuku, Fiji Islands; depth, 315 fathoms.

Cryptolaria geniculata is, of all the species of *Cryptolaria*, the most strongly defined,—so distinct is it indeed that one might almost be justified in assigning it to a new generic group. The valvular orifice of the hydrothecæ affords in itself a striking character, while the singularly geniculate form of the stem is a condition not met with in any other known species of *Cryptolaria*.

The hydrothecæ when traced to their origin from the axial tube are seen to be funnel-shaped, gradually tapering away from the orifice to the point of origin, and curving gently and with great elegance away from the supporting tube. The orifice is capable of being closed by the two membranous valves, which meet so as to form a ridge like that of the roof of a house, and which are composed of numerous, easily separated, very thin laminæ.

Cryptolaria geniculata is one of the three species in which the gonosome has been detected. While the two others—*Cryptolaria abyssicola* and *Cryptolaria diffusa*—have been dredged from the great depths of 2600 and 2500 fathoms respectively, the present species has been brought up from the comparatively moderate, though still very considerable, depth of 315 fathoms.

Cryptolaria gracilis, n. sp. (Pl. XX. figs. 2, 2*a*).

Trophosome.—Colony attaining a height of about two inches; stem slender, flaccid, much and irregularly branched, and with the distal portion for a great extent destitute of the peripheral tubes. Hydrothecæ alternate and distichous.

Gonosome not known.

Locality.—Station 169, near New Zealand; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms.

Cryptolaria gracilis is an unusually well marked species. It forms small, tree-like, much-branched colonies, and while the slender flexile branches have their distal portions formed as in the other species by the free extension of the axial tube, this tube is here destitute of the peripheral investment for a greater extent than is the case in any other with which I am acquainted. It is apparently on this condition that the slenderness and flaccidity of the branches mainly depends.

Cryptolaria diffusa, n. sp. (Pl. XXI. figs. 1, 1*a*).

Trophosome.—Stem slender, loosely and irregularly branched. Hydrothecæ narrow, rather widely set, and with a nearly dichotomous arrangement.

Gonosome.—Gonangia springing from distance to distance along the stem, flask shaped, about twice the width of the hydrothecæ, curving away from the stem, solitary or geminate.

Locality.—Station 101, off Sierra Leone; depth, 2500 fathoms.

This is a very loosely branched slender form, with a straggling unattractive habit, and is of special interest from the great depth at which it has been found, and from the fact that it is one of the only three species of *Cryptolaria* in which the gonosome has been detected.

As in the other species of *Cryptolaria* in which the gonangia have been found, these receptacles spring from the axial tube where this is covered by the peripheral, and have their distal ends curving away from the stem. In *Cryptolaria diffusa*, however, they present the singular feature of being sometimes geminate, while this condition is found on the same branch which carries the ordinary solitary form of gonangium. The geminate gonangia spring from a very short common peduncle, and immediately become adherent, back to back, for about three-fourths of their height, the distal fourth being free and divergent. It is impossible with our present knowledge to assign with confidence any reason why there should be this difference in the gonangia of one and the same colony. If it be not an abnormal occurrence of merely individual significance, it may possibly point to a monœcious condition of the colony, involving a sexual difference between the solitary and geminate gonangia.

Perisiphonia, n. gen.

Name from περὶ, around, and σίφων, a tube, in allusion to the way in which the axial tube is surrounded by the peripheral ones.

Generic Character. Trophosome.—Hydrocaulus composed of two constituents, an axial and a peripheral; the axial formed by a continuous tube which carries at intervals along its length pedunculated hydrothecæ; the peripheral formed by numerous tubes which completely surround the axial in its entire length, are destitute of hydrothecæ, but allow the hydrothecæ of the axial tube to project through interstices between them into the surrounding water; the superficial tubes of the peripheral fascicle set with tubular sarcothecæ.

This remarkable genus has very obvious affinities with *Cryptolaria*, from which, however, it essentially differs in its hydrothecæ being provided with well-defined peduncles, instead of having their cavities directly continuous with that of the tube from which they spring, in the axial tube never becoming free from the cover of the peripheral, and in the presence of a well-developed system of sarcode-bearing receptacles.

In *Perisiphonia filicula* and in *Perisiphonia pectinata*, the only two species as yet known, the hydrothecæ are flask-shaped and are disposed alternately in regular sequence along the entire length of the axial tube. The peripheral tubes completely envelop the axial, are continuous throughout the entire length of the branch, and although separable as in the other Perisiphonidæ, are adherent to one another except at the places through which the ends of the hydrothecæ protrude. Hence no part of the axial tube becomes exposed as in *Cryptolaria*, the peripheral tubes continuing to invest it to the extreme ends of the branches.

Another very remarkable feature in *Perisiphonia* consists in the presence of minute tubular receptacles which are borne by the superficial tubes of the peripheral fascicle. In both species these are carried all along the length of the tubes, and under a low

magnifying power they give a hirsute appearance to the surface of the colony. They are in the form of very slender cylindrical tubes, open at the summit, and contain a granular matter which is directly continuous with the contents of the peripheral tube from which they spring. In *Perisiphonia filicula* similar receptacles occur in connection with the axial system, one being here fixed on the peduncle of every hydrotheca, while the lateral offsets of the axial tube in this species carry each a pair of such bodies near their origin.

These little receptacles must certainly be regarded in the same light as the sarcothecæ or nematophores so characteristic of the Plumularinæ, which in some rare cases are also present in a modified form among other groups of the Hydroida.

That their contents, like those of the nematophores of the Plumularinæ, consist essentially of sarcode—whether in connection with a true cell-tissue or not—there can be very little doubt, and, judging from the analogy of the Plumularinæ, it is also nearly certain that, like the sarcothecæ of these, their contents have the power of emitting pseudopodial extensions of the enclosed sarcode.

A living specimen of a *Perisiphonia* must thus when seen under the microscope present an appearance as singular as it must be beautiful; for besides the flower-like hydranths which expand over the surface of the colony, countless fine contractile filaments of sarcode will be seen like the pseudopodia of the Foraminifera extending in all directions into the surrounding water.

Perisiphonia filicula, n. sp. (Pl. XXII. figs. 1–4).

Trophosome.—Colony attaining a height of between two and three inches, stem simple or sparingly branched, and very regularly set with pinnately disposed opposite or subopposite ramuli. Hydrothecæ flask-shaped, curving away from the axial tube, and with the neck short and stout.

Gonosome not known.

Locality.—Station 75, near the Azores; lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms.

Station 163A, off Twofold Bay, Australia; depth, 150 fathoms.

Perisiphonia filicula is a rather strong, rigid species, and in common with *Perisiphonia pectinata*, presents in its nearly opposite ramuli a distinct and easily recognised physiognomy. The somewhat robust stem springs from a complex plexus of tubular filaments, and soon begins to send off from each side its pinnately disposed ramuli. These are considerably more slender than the stem, and are either opposite or so nearly opposite that close inspection is necessary in order to discover any deviation from an exactly opposite arrangement. This deviation, however, becomes sufficiently obvious when the pinnæ are traced to their origin from the axial tube of the stem. It is only

at the points where they leave the peripheral fascicle that they show any decided approximation to an opposite disposition.

Under a low power the whole surface may be seen to be thickly studded with the little tubular sarcothecæ, which constitute so remarkable a character of the genus. The hydrothecæ project but slightly from the surface and are regularly alternate and distichous, with entire circular orifice. When the axial tube of the stem is carefully exposed by the removal of the investing peripheral tubes, it will be seen that close to the base of several of the hydrothecal peduncles a branch is sent out at nearly a right angle from the main tube, from which it scarcely differs in thickness. Some of these branches soon terminate abruptly, while others are continued beyond the peripheral fascicle, bear pedunculated hydrothecæ, and constitute the axial portion of a lateral ramulus or pinna. This becomes surrounded by a fascicle of peripheral tubes, which are given off from the peripheral tubes of the stem. The peduncle of every hydrotheca carries a sarcotheca similar to those of the peripheral tubes, while two or three similar bodies are also frequently borne by the lateral offset near its base. The peripheral tubes terminate at the distal end of the ramuli in truncated but apparently closed extremities, and no part of the axial tube is here exposed, as is always the case in *Cryptolaria*.

The walls of the peripheral tubes are much thinner than those of the axial, and under the action of certain reagents, as caustic potash, shrivel and collapse, while the axial tube retains almost completely its original form. About ten tubes usually enter into the composition of the peripheral fascicle of a pinna.

Perisiphonia pectinata, n. sp. (Pl. XXI. figs. 2, 2*a*, 2*b*).

Trophosome.—Colony with the main stem sparingly branched, attaining a height of about five inches, stem and branches thick, carrying pinnately disposed, equidistant, nearly opposite, slender ramuli. Hydrothecæ flask-shaped, curved away from the axial tube, and with the neck rather long and slender.

Gonosome not known.

Locality.—Station 169, off New Zealand; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms.

The very regular, nearly opposite, disposition of the ramuli in this species is accompanied by a somewhat rigid habit, which gives a pectinate aspect to the branches. The more elongated and more slender neck of the flask-shaped hydrothecæ, and its greater extension beyond the surface of the peripheral fascicle, are among the characters which distinguish *Perisiphonia pectinata* from *Perisiphonia filicula*. Another point in which the present species differs from *Perisiphonia filicula* will be found in the greater slenderness of the pinnately disposed ramuli, which have here not more than half the diameter of these ramuli in *Perisiphonia filicula*. The slenderness of the pinnæ in

Perisiphonia pectinata is the result not only of the small number of peripheral tubes which enter into their composition, but of the fact that both peripheral and axial tubes are themselves more slender in this species than in the other. While the number of peripheral tubes in the pinnæ of *Perisiphonia filicula* is as many as ten or possibly more, I have always found the number of these tubes in the peripheral fascicle of *Perisiphonia pectinata* to be limited to six.

The superficial sarcothecal system is particularly well developed in *Perisiphonia pectinata*, in which the sarcothecæ are considerably longer than in *Perisiphonia filicula*. They spring from the peripheral tubes by a slightly dilated base.

Family GRAMMARIDÆ.

Character of the Family. Trophosome.—Hydrocaulus consisting of an axial tube which carries the hydrothecæ, and is entirely surrounded by a definite number of peripheral tubes which are destitute of hydrothecæ. Axial and peripheral tubes inseparably coalesced. All the hydrothecæ adnate by their sides to the axial tube. Hydranths with conical hypostome.

Gonosome not known.

Grammaria, Stimpson.

Gammaria, Stimpson, Marine Invertebrata of Grand Manan.

Generic Character.[1] *Trophosome.*—Colony, a ramified hydrocaulus composed of a fascicle of longitudinal tubes definite in number and inseparably adnate to one another, of which one is axial and the others peripheral, the axial tube entirely covered by the peripheral, and sending off, from distance to distance along its length, tubular, non-pedunculated hydrothecæ, which are at first adnate to it by their sides, and then, passing between the peripheral tubes, reach the surface of the fascicle, where they form definite longitudinal series directed on all sides round its circumference.

Gonosome not known.

The tubes which are combined into the fascicle which forms the stem and branches of the colony in *Grammaria* are very definite in number and arrangement, though their close adhesion to one another renders it difficult to determine their exact relation to the hydrothecæ. One of these tubes always occupies the axis of the fascicle and gives off from distance to distance the hydrothecæ, which are at first inseparably adnate to the tube from which they spring, and then, becoming free, bend outwards between the peripheral tubes so as to reach the surface of the fascicle, and thence project into the surrounding water.

[1] The facts brought to light by a study of the specimens of *Grammaria* obtained by the Challenger have rendered necessary a fundamental revision of the characters hitherto regarded as diagnostic of this genus.

In a transverse section of a branch of *Grammaria magellanica*, three hydrothecæ (Pl. XXIII. fig. 2^b, *b*) may be seen nearly in the same plane projecting from the circumference of the branch, and at equal distances from one another, while alternating with these may be seen in section three others (*a*), whose bases lie in a plane above that of the former and whose distal ends have been removed by the section. Again alternating with the last may be seen the sections of three others (*a*) which spring from the axial tube in a plane still nearer to the observer, and have consequently a greater portion cut off by the section. These last, from the fact of the section passing nearer to their origin, are filled with the basal portion of the hydranth. The hydrothecæ of *Grammaria magellanica* are thus arranged in six longitudinal series, so disposed that the hydrothecæ of the six series lie in a succession of transverse planes, each plane containing three hydrothecæ, which exactly alternate with those of the plane on each side of it.

A similar disposition exists in *Grammaria stentor*, while in *Grammaria insignis* the number of longitudinal series is four, each transverse plane containing two nearly opposite hydrothecæ (fig. 3^b, *b*) which alternate with those immediately above and below them. The arrangement as seen in all these instances in transverse sections of a branch is thus very regular and symmetrical.

Lying external to the axial tube and its hydrothecæ are the peripheral tubes of the fascicle. These were always six in number in the species which I examined. They run quite superficially, and here and there separate in order to give exit to the free portion of the hydrothecæ. They accompany the axial tube to its distal extremity, resembling in this respect the peripheral tubes of *Perisiphonia*, and differing from those of *Cryptolaria*, in which the axial tube for a greater or less extent towards its distal end ceases to be covered by the peripheral.

All the tubes entering into the composition of the fascicle, not excepting even the included portion of the hydrothecæ, are in such close approximation as to assume a prismatic form, and are inseparably adherent to one another. So intimate is this adhesion that I have found no treatment, even prolonged boiling in caustic potash, capable of in any way overcoming it. *Grammaria* in this respect presents a striking contrast to *Cryptolaria* and *Perisiphonia*, as well as to the other genera of the Perisiphonidæ, in all of which maceration in a solution of caustic potash so weakens the adhesion of the tubes to one another that these may then be easily separated by the dissecting needle.

As in *Cryptolaria* so also in *Grammaria* it is difficult to find characters available for the systematic diagnosis of the species. Throughout the genus the hydrothecæ present but little variation, while the gonosome from which differential characters might be expected has not yet been found in any species. A really good character is afforded by the number of longitudinal series in which the hydrothecæ are disposed upon the stem and branches, but even here the variation takes place within very narrow limits, six and four having been as yet the only numbers in which the longitudinal series of hydrothecæ

are known to be present. Beyond these variations the ramification and general habit of the colony afford almost the only grounds for the systematic differentiation of the species.[1]

Grammaria stentor, n. sp. (Pl. XXIII. figs. 1, 1*a*).

Trophosome.—Colony attaining a height of between three and four inches, set with pinnately disposed ramuli which are alternate, subopposite or opposite, thinner than the stem, and often carrying secondary ramuli similar in disposition to the primary ones. Hydrothecæ rather long and wide and abruptly though slightly dilated at the orifice, and disposed in six longitudinal series.

Gonosome not known.

Locality.—Station 149D, Royal Sound, Kerguelen; depth, 28 to 60 fathoms.

This is a strong-growing species with the main stem thick towards the base and becoming gradually thinner towards the distal end. From either side the stem sends off pinnately disposed ramuli, which are sometimes opposite, but more frequently alternate or subopposite. The pinnæ, except at their origin, where, as in all the known species they are greatly constricted, are of uniform thickness. They are thinner than the stem from which they spring, and are sometimes simple, sometimes pinnately branched.

The graceful curve of the rather wide tubular hydrothecæ, and the slight trumpet-like dilatation of the orifice, confer on a magnified view of this fine species an aspect of great elegance.

Grammaria magellanica, n. sp. (Pl. XXIII. figs. 2, 2*a*, 2*b*).

Trophosome.—Hydrocaulus set with pinnately disposed alternate ramuli which are given off at rather wide intervals, and very much contracted at their origin. Hydrothecæ cylindrical, with even, circular, non-everted orifice, and disposed in six longitudinal series.

Gonosome not known.

Locality.—Station 314, near the Falkland Islands; lat. 51° 5′ S., long. 65° 39′ W.; depth, 70 fathoms.

The specimens of this species are fragmentary, the hydrorhizal extremity has in no instance been preserved, and the size and general habit of the Hydroid cannot be

[1] Mr. Hincks regards Lamouroux's genus *Salacia* (Exposition Méthodique, p. 15) as identical with the *Grammaria* of Stimpson, whose name he accordingly suppresses in favour of the earlier one. If, however, Lamouroux had really a *Grammaria* before him, his figure of it is altogether so bad, and his description so inadequate, that it is impossible to feel satisfied in the identification with *Grammaria* of the zoophyte to which the French zoologist assigned the name *Salacia*; so that even though Mr. Hincks be right in his reference of the *Grammaria* of Stimpson to the *Salacia* of Lamouroux, the uncertainty which must always hang over the nature of Lamouroux's animal will fully justify us in accepting Stimpson's name for a genus which this zoologist has described so fully as to leave no doubt as to the form intended by him.

ascertained with accuracy. The largest fragments measured about one inch and a half in height, and the pinnately disposed branches attained a length of from one-half to three-fourths of an inch. Hydrothecæ in all respects like those of the branches are carried by the stem along its entire length. The branches, as in all the known species of *Grammaria*, are greatly contracted at their origin. This contracted portion is occupied by a simple cavity into which the tubes of the compound branch open.

Grammaria insignis, n. sp. (Pl. XXIII. figs. 3, 3*a*, 3*b*).

Trophosome.—Colony attaining a height of six inches, set with pinnately disposed alternate ramuli, which often carry secondary ramuli with a similar disposition. Hydrothecæ cylindrical, not dilated at the orifice, disposed in four longitudinal series.

Gonosome not known.

Locality.—Station 145, off Marion Island; depth, 50 to 75 fathoms.

This is a large and handsome species. The main stem is towards its base much thicker than the ultimate ramuli, but gradually tapers towards the distal end of the colony. The hydrothecæ, as in all the known species of *Grammaria*, are borne both along the stem and the branches, and the ultimate ramuli are here, as in every other known species, very much constricted at the origin. *Grammaria insignis* is the only species of *Grammaria* in the collection which has its hydrothecæ disposed in four longitudinal series. In all the others six such series are present.

Family SERTULARIDÆ.

Character of the Family. Trophosome.—Hydrothecæ in two or more series, with the cavity differentiated by a more or less complete floor from that of the hydrocaulus, to which their sides are for a greater or less extent adnate. Hydrocaulus not formed by inseparably coalesced tubes, of which one is axial and carries the hydrothecæ, and the others peripheral, definite in number, and destitute of hydrothecæ. Hydranths with conical hypostome.

Gonosome.—Gonophores hedrioblastic.

Sertularia, Linnæus (in part).

Sertularia, Linnæus, Syst. Nat. (Gmel.), p. 3844.

Generic Character. Trophosome.—Hydrocaulus simple or branched, divided by equidistant joints into internodes, each carrying a pair of opposite hydrothecæ, or two alternate hydrothecæ, or a single one. Hydrothecæ sessile, in two series,

flask-shaped, or barrel-shaped, or cylindrical, with the margin entire or variously cleft or dentate, and with the sides to a greater or less extent adnate to the hydrocaulus, orifice with or without an operculum. Hydranth with conical hypostome.

Gonosome.—Gonophores adelocodonic, gonangia springing from one side of the hydrocaulus, each from a point near the base of a hydrotheca, and without a chitinous marsupium in either sex.

The old Linnæan genus *Sertularia* included, as may well be expected, many forms which subsequent systematists have placed in distinct generic groups. Even after the *Sertularia* of Linnæus had undergone the revision to which it had been subjected by Lamouroux and by Lamarck, there still remained species which later authors believed themselves justified in removing from it.

J. E. Gray broke up the genus *Sertularia* as left by Lamarck into two genera, *Sertularia* and *Sertularella*, the former including such species as had their hydrothecæ opposite, and the latter such as had them alternate. The insufficiency of the grounds on which this dismemberment was based soon became apparent, and Hincks, while accepting Gray's genus *Sertularella*, attempted to give it a greater systematic value by connecting with it characters of more importance than those derived merely from the alternate disposition of the hydrothecæ. The characters especially insisted on by Hincks as affording legitimate grounds for the dismemberment proposed by Gray are found in the condition of the margin of hydrotheca, which in *Sertularella* carries three or four denticles or cusps, and gives support to an operculum formed of three or four triangular membranous valves; while in *Sertularia* proper the margin is either even or with a simple cleft, and according to Hincks is destitute of an operculum.

Since the time when Hincks published his history of British Hydroid Zoophytes, many species from various parts of the world have come under examination, and show that the distinctions relied on in that valuable work have by no means the systematic importance which had been attributed to them. Some species which by their even or merely cleft hydrothecal margin would come under *Sertularia* proper have their hydrothecæ as truly alternate as in the most typical representatives of *Sertularella*, and even the characters derived from the presence of an operculum in *Sertularella*, and its supposed absence in *Sertularia*, are found to be by no means of universal application. Some species whose hydrothecæ in no essential point differ from those of the typical *Sertularia pumila*, either in the condition of the rim or in their absolutely opposite disposition (*e.g.*, *Sertularia distans* and others, see Hydroids of the Gulf Stream), are provided with opercular membranous valves, and yet few systematists would think of separating these generically from the closely allied species in which no valves are present.

What has been called the operculum consists in most cases of three or of four very thin membranous triangular valves, composed, like the general perisarc, of chitin, and

forming when in apposition a four-sided or three-sided pyramidal roof for the hydrotheca. In some cases (*e.g.*, *Sertularia distans*) there are but two valves, and these when in apposition form a wedge-shaped roof over the orifice of the hydrotheca.

The valves in all these cases are so thin and perishable that it is only in recent or exceptionally well preserved specimens we can hope to meet with them, a fact which in itself deprives the distinctions derived from them of that practical value which ought if possible to be found in all well-selected systematic characters.

On the grounds here adduced, then, I must regard the removal from *Sertularia* of the species for which Gray founded his genus *Sertularella* as a step not borne out by fundamental differences in the species; and although Gray's revision has been adopted by so high an authority as Hincks, and though I had followed it myself in former publications, I shall in the present Report suppress the genus *Sertularella* and refer to *Sertularia* all species which agree with the diagnosis of this genus as given above.

A revision much more in accordance with natural affinities was proposed by Agassiz, who, under the name of *Diphasia* separated from *Sertularia* those species in which the female gonangium differs from the male in possessing an external chamber with chitinous walls, into which the ova are expelled from the main cavity of the gonangium in order to pass through certain stages of their development before escaping into the surrounding water.

Sertularia gracilis, n. sp. (Pl. XXIV. figs. 1, 1*a*).

Trophosome.—Stem monosiphonic, slender, profusely branched; primary ramification pinnate or subpinnate, many of the primary and secondary branches presenting a similarly pinnate or subpinnate ramification. Hydrothecæ alternate, distant, one borne on every internode, nearly cylindrical, adnate to the internode for about two-thirds of their height, then bending outwards; orifice with a broad cusp on each side.

Gonosome.—Gonangia springing each from a point just below the base of a hydrotheca, urniform, with very prominent annular ridges, distal end continued as a narrow cylindrical tube, which carries the even, circular orifice on its summit.

Locality.—Station 312, Port Famine, Patagonia; lat. 53° 37′ 30″ S., long. 70° 56′ 0″ W.; depth, 9 fathoms.

This slender and very elegant species was brought up in luxuriant masses about five inches in height, and richly laden with gonangia. The ramification, which is very profuse, commences with pinnately disposed branches, many of which soon branch in a similar way, and the primary ramification is further repeated in ramuli of a secondary, tertiary, and even higher order. The branches are given off each close to the base of a hydrotheca.

The gonangia are very beautiful. The regularity and prominence of the annular ridges constitute a feature in the highest degree attractive. The distal end is prolonged into a short, wide neck, which terminates in a saucer-shaped summit, from the centre of which rises a narrow, cylindrical tube, which carries the relatively small orifice of the gonangium.

The annular ridges, which are very prominent on the apocauline or outer side of the gonangium, are nearly obsolete on the inner or epicauline side, a condition which is obviously connected with the close proximity of this side to the opposed surface of the stem.

Sertularia gracilis has considerable resemblance to *Sertularia tricuspidata*, Alder. It differs from it in the absence of annulation at the distal side of every hydrotheca, in the hydrothecæ having only two marginal cusps, and in the more elongated gonangia.

Sertularia annulata, n. sp. (Pl. XXIV. figs. 2, 2*a*).

Trophosome.—Stem fascicled towards the base, becoming monosiphonic distally, irregularly or subpinnately branched, set with pinnately disposed, alternate ramuli, stem and ramuli divided into short internodes, every internode carrying a hydrotheca. Hydrothecæ alternate, nearly cylindrical, adnate to the internode for somewhat more than half their height, then becoming free and divergent, distinctly annulated for some distance from the orifice, margin of orifice with four short, broad cusps.

Gonosome not present.

Locality.—Station 163B, off Port Jackson, Australia; depth, 35 fathoms.

Sertularia annulata is a strong-growing form. The main stem and its principal branches are stout, and fascicled towards the proximal ends, but become monosiphonic distally, and are regularly set with rather long, alternate, equidistant, monosiphonic pinnæ. The annulation of the hydrothecæ is well marked, and extends from the orifice about halfway towards the base.

Sertularia leiocarpa, n. sp. (Pl. XXV. figs. 1, 1*a*).

Trophosome.—Hydrocaulus monosiphonic, irregularly branched, geniculated, every internode increasing in thickness from its proximal to its distal end. Hydrothecæ alternate, springing from the salient angles of the geniculations, distant, deep, tubular, narrowing towards the summit, adnate to the internode for about one-third of their height, then diverging at a wide angle, and terminating in a subquadrate orifice with four minute cusps.

Gonosome.—Gonangia large, oviform, perfectly smooth, narrowing below into a short peduncle which springs from a point just below a hydrotheca, and terminates in a short and wide tubular prolongation which carries the circular entire orifice.

Locality.—Station 135c, Nightingale Island; depth, 100 to 150 fathoms.

Sertularia leiocarpa is a rather strong-growing form with large distant hydrothecæ, each borne close to the distal end of an internode, where the hydrocaulus forms a well-marked geniculation. The joints separating the internodes are often obscure. The specimen has a height of about three inches, and springs from a small plexus of hydrorhizal filaments, while the proximal end of the stem is for some distance destitute of hydrothecæ.

The gonangium is large, its height exceeding twice that of an internode. It is perfectly smooth, showing no trace of annulation or rugæ.

The perisarc is transparent and allows of a good view of the included soft parts, which are well preserved in the specimen. The hydranths have about fifteen tentacles, and in extreme retraction present a condition hitherto unnoticed among Hydroids, the gastric cavity emitting then a lateral, long, hernia-like protrusion which extends from the base of the hydranth to a point beyond the origin of the tentacular crown (fig. 1*a*). This remarkable condition gives to the body of the hydranth the appearance of being doubled on itself, and forcibly recalls the formation of the alimentary canal in a Polyzoon.

The fleshy bands which extend from the sides of the gonophore to the walls of the gonangium were well preserved, and at their points of attachment to the gonangium were flattened out in a stellate fashion. The bands had often become broken away from their points of attachment, leaving these behind in the form of stellate cells (fig. 1*a*).

Sertularia unilateralis, n. sp. (Pl. XXV. figs. 2, 2*a*, 2*b*).

Trophosome.—Hydrocaulus many times pinnately branched, forming a dense tuft in which the ramuli are all directed towards one side of the colony. Hydrothecæ alternate, borne close to the distal end of each internode, those of opposite sides lying in two different planes, adnate to the internode for about one-third of their height, epicauline side ventricose towards the base, margin divided into four strong teeth, and with a thickened rim.

Gonosome.—Gonangia oviform, equalling in height about three internodes of the stem, attached by a short peduncle to the internode just below a hydrotheca, annulated for the greater part of their height, and opening by a tridentate terminal orifice.

Locality.—Station 149, off Accessible Bay, Kerguelen Island; depth, 20 fathoms.

Sertularia unilateralis by the profusion of its branches forms a dense tuft which is upwards of an inch in height, and in which the ramification is rendered remarkable by

having the ramuli all directed towards one and the same side, so as to give to the colony a front and a back aspect. In the hydrothecæ also a similar unilateral direction is apparent, for those of opposite sides, instead of lying as usual in a single plane, are directed obliquely towards one side of the stem, and thus lie in two planes which converge towards its axis.

Sertularia clausa, n. sp. (Pl. XXV. figs. 3, 3*a*).

Trophosome.—Stem slender, transparent, irregularly branched, internodes carrying each a single hydrotheca. Hydrothecæ alternate, distant, conical, slightly tumid below, adnate to the internode for about half their height, then diverging; orifice subquadrate, covered by a pyramidal lid which is composed of four triangular valves.

Gonosome not present.

Locality.—Station 320, off Monte Video; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom, green sand; bottom temperature, 37°·2.

Sertularia clausa is a small, much-branched, slender form, with a thin very transparent perisarc. The branches are given off at a wide angle, each from a point just below the base of a hydrotheca, and are irregular in their disposition and direction. The hydrothecæ are separated from one another by rather wide intervals. From a somewhat wide base they become gradually narrower towards the orifice, which is obscurely quadrate. As in many other species, the orifice is provided with a membranous four-valved operculum, but instead of this being filmy and perishable as in most of the species which possess it, it has here considerable firmness and forms a well-developed, permanent, pyramidal lid. This is composed of four triangular valves, which when in apposition form the four sides of a pyramid.

The delicacy and transparency of the periderm is probably connected with the very considerable depth of 600 fathoms from which the species was dredged.

Sertularia implexa, n. sp. (Pl. XXVI. figs. 1, 1*a*).

Trophosome.—Stem profusely and irregularly branched; branches slender, given off in all directions, and forming loosely entangled masses. Hydrothecæ alternate, rather distant, deep, adnate to the internode for somewhat less than half their height, apocauline side nearly plane, epicauline side ventricose, orifice with the margin divided into four teeth and provided with four delicate membranous valves.

Gonosome not present.

Locality.—Station 314, between Cape Virgins and the Falkland Islands; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms.

Sertularia implexa grows in complex entangled tufts which attain a height of nearly three inches. The hydrothecæ are borne close to the distal ends of the rather long internodes, and their margin is divided into four triangular equidistant teeth, whose intervals support four very delicate, membranous, triangular valves, which, when in apposition, form a pyramidal roof over the orifice of the hydrotheca. The branches spring each from a point close to the base of a hydrotheca.

Sertularia exigua, n. sp. (Pl. XXVI. figs. 2, 2*a*).

Trophosome.—Stem monosiphonic, slender, much and irregularly branched, divided by well-marked joints into equal internodes, which are slightly inclined at an angle to one another, each internode carrying a single hydrotheca near its distal end. Hydrothecæ alternate, distant, adnate to the internode for about half their height, then diverging at a rather wide angle, tumid below, much narrower and cylindrical towards the four-toothed orifice.

Gonosome.—Gonangia borne by the internodes near the bases of the hydrotheca, oviform, annulated, tapering below to a narrow point of attachment; orifice tridentate, borne on a short tubular extension of the summit.

Locality.—Station 75, near the Azores; lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms.

Sertularia exigua is a very slender profusely branched species. The internodes are inclined to one another at a slight angle, so that the stem presents a somewhat zigzag or geniculate form. The hydrothecæ are distant, and present a sufficiently obvious character in their narrow cylindrical distal end with its four-toothed margin.

The gonangia are in most cases distinctly annulated. Sometimes, however, the annulation is nearly obliterated.

The species comes very near to *Sertularia polyzonias*, from which it differs chiefly in its much more slender habit and in the narrower and more elongated free portion of the hydrothecæ.

Sertularia polyzonias, Linnæus (Pl. XXVI. figs. 3, 3*a*).

Sertularia polyzonias, Linn., Syst. Nat. (Gmel.), p. 3856.
„ „ Lamk., Anim. sans Vert. (Ed. 2), t. ii. p. 142.
Sertularella polyzonias, Hincks, Brit. Hydroid Zooph., p. 235, pl. xlvi. fig. 1.

Trophosome.—Stem monosiphonic, irregularly branched. Hydrothecæ alternate, distant, adnate to the internode for about one-third of their height, then divergent, tumid below, contracted and cylindrical towards the quadrate, four-toothed orifice.

Gonosome.—Gonangia each springing from a point just below a hydrotheca, elongated ovate, tapering below into an ill-defined peduncle, strongly annulated, with a terminal obscurely four-toothed orifice.

Locality.—Station 315, Port William, Falkland Islands; lat. 51° 40′ S., long. 57° 50′ W.; depth, 5 to 12 fathoms.

There do not appear to be any legitimate grounds for separating the form here described from the widely distributed *Sertularia polyzonias*. Though the specimen is scarcely more than an inch in height it has probably attained nearly its full size, as the presence of a well-developed gonosome would seem to indicate. It is thus of much humbler habit than the typical *Sertularia polyzonias*, from which it further differs in the more elongated and more deeply annulated gonangia. These differences, however, I regard as merely local variations to which we should not be justified in assigning a specific value. The membranous valves of the hydrotheca had not been preserved so as to be recognisable in the specimen.

The specimen here described was dredged in the region of the Falkland Islands. The collection also contains specimens obtained at Port William, which I do not hesitate to refer to the same species.

Sertularia exserta, n. sp. (Pl. XXVII. figs. 1, 1*a*, 1*b*, 1*c*).

Trophosome.—Hydrocaulus monosiphonic, slender, subdichotomously and profusely branched, divided by distinct joints into internodes, each of which carries a hydrotheca. Hydrothecæ exactly alternate, each borne at the distal end of an internode, adnate to the internode for about one-third of their height, deep, nearly cylindrical, margin of orifice with two strong cusps at its apocauline side, and one at its epicauline side. Hydranths incapable of complete retraction within the hydrothecæ.

Gonosome.—Gonangia springing each from a point just below the base of a hydrotheca, oviform, encircled by very prominent transverse annular ridges, and terminating distally in a short neck with a saucer-like terminal expansion which carries the orifice.

Locality.—Station 151, off Heard Island; depth, 75 fathoms.

Sertularia exserta is a very beautiful and interesting species. Its hydranths, like those of *Thuiaria hyalina* (Pl. XXXIII. figs. 2, 2*a*), are incapable of complete retraction, the tentacular crown being never withdrawn into the hydrotheca; and here also as in that Hydroid the body of the hydranth sends off in all directions fleshy bands (fig. 1*a*) by which it becomes tied to the hydrotheca-walls, and is thus rendered incapable of that complete retraction by which in ordinary cases the hydranth is enabled to retire within the cavity of the hydrotheca.

In this imperfect retraction of the hydranth we have a condition which may be

compared with that of the various species of *Halecium*. While in these, however, the hydrothecæ are evanescent, and not only the tentacular crown but the body of the hydranth always remains uncovered, in *Sertularia exserta* and in *Thuiaria hyalina* the hydrothecæ are especially well developed, and though the tentacular crown in these two Hydroids always remains exposed, the body of the hydranth remains under cover of the hydrotheca.

Another feature of great interest and significance is found in the fact that in the present species every tentacle is provided at its base with a remarkable organ in the form of a little cushion-like prominence loaded with slightly curved, rod-shaped thread-cells (figs. 1*b*, 1*c*). It is scarcely possible not to recognise in these little batteries of thread-cells defensive organs compensating for the loss of the protection which in other cases is afforded by the hydrothecæ. Whether, however, similar organs occur in the equally exposed hydranths of *Thuiaria hyalina* the state of the specimen did not allow me to determine; while we cannot overlook the fact that in the still more exposed hydranths of *Halecium* no such organs have been detected.

The gonangia of *Sertularia exserta* are exceedingly beautiful. The thin but very prominent annular ridges with which they are encircled give to them the appearance of a symmetrical pile of discs, while the profusion in which the gonangia are developed gives to the entire colony an aspect no less pleasing than striking.

The specimens in the collection have a height of between one and two inches, while the comparatively good state of preservation in which the soft parts are retained allowed of a satisfactory determination of the points here described.

Sertularia echinocarpa, n. sp. (Pl. XXVIII. figs. 1, 1*a*).

Trophosome.—Stem fascicled towards the root, becoming monosiphonic distally, pinnately branched, branches alternate. Hydrothecæ alternate, large, tubular, cylindrical, slightly tumid towards the base on the apocauline side, free for about two-thirds of their height, orifice quite even and circular.

Gonosome.—Gonangia springing each by a short peduncle from a point close to the base of a hydrotheca, pyriform, thickly set with hollow, blunt, spine-like outgrowths of their chitinous perisarc.

Locality.—Station 149D, Royal Sound, Kerguelen Island; depth, 28 to 60 fathoms.

Sertularia echinocarpa is a large and strong form, attaining a height of upwards of six inches. The main stem is slightly wavy and set with hydrothecæ along its entire length. It sends off at nearly equal intervals shorter pinnately disposed alternate branches, which are set with hydrothecæ and differ in no respect except in length from the main stem.

The long tubular hydrothecæ, free for the greater part of their height, afford a very

obvious character. They are strictly alternate; their orifice is perfectly circular and destitute of serration, and it thus presents a character which is exceptional among the *Sertulariæ* with alternate hydrothecæ. Here and there a well-marked transverse joint occurs just above the base of a hydrotheca, but this is found at distant and uncertain intervals, and elsewhere the joints are nearly or quite obliterated.

Immediately below the base of every hydrotheca are two oval spaces in which the chitinous periderm is very thin and transparent. They occur one on each side of the hydrotheca, and have the appearance of apertures in the perisarc. It is from these spaces that the gonangia take their origin. The greater number, however, are found with no gonangia attached to them; and as they are quite constant and occur on both sides of the hydrothecæ, we cannot regard them as indications of the points from which gonangia had already fallen. Similar transparent aperture-like spaces are by no means unusual among the Sertularian Hydroids. I am not able to assign to them their real significance.

The gonangia constitute a very striking character in the species. They are pyriform vesicles, thickly covered with long blunt spine-like outgrowths of their walls, these are hollow and open into the cavity of the gonangium.

Sertularia catena, n. sp. (Pl. XXVIII. figs. 2, 2*a*).

Trophosome.—Hydrocaulus fascicled, becoming monosiphonic distally; internodes inclined to one another at a very decided angle, gradually widening from their proximal towards their distal ends, where each carries a hydrotheca. Hydrothecæ alternate, large, deep, cylindrical, with four low marginal cusps, every hydrotheca springing by its base from a point near the distal end of an internode, and free for somewhat more than two-thirds of its course.

Gonosome.—Gonangia springing each from an internode at a short distance below the base of a hydrotheca, elongate ovate, destitute of annulation, with a small terminal, bicuspate orifice.

Locality.—Station 24, off Culebra Island, West Indies; depth, 390 fathoms.

Sertularia catena, though a rather strong-growing form, does not appear to attain a large size, the specimen in the collection measuring about two inches in height. Its large, cylindrical hydrothecæ, except at the base where they rest on the supporting internode, and for a short extent of the epicauline side, are entirely free from the hydrocaulus. The internodes are clavate in form, and each springs by its narrow end from the wide end of the internode which precedes it, and to which it is inclined by a well-pronounced angle, thus giving to the hydrocaulus a decidedly geniculate habit, which is rendered still more obvious by the direction of the hydrothecæ, whose axis is always in direct continuation with that of the supporting internode.

Sertularia geniculata, n. sp. (Pl. XXVIII. figs. 3, 3*a*, 3*b*).

Trophosome.—Stem monosiphonic, very slender and hyaline, irregularly branched, internodes very long, inclined to one another at a wide angle so as to give a geniculate form to the stem. Hydrothecæ alternate, borne close to the distal ends of the internodes, to which they are adnate by about one-third of their epicauline side, very deep, tumid towards the base, and thence gradually narrowing and becoming cylindrical towards the summit, which is occupied by the quadrilateral orifice.

Gonosome.—Gonangia obovate, with truncated summit, springing by a narrow proximal end from a point on the internode just below the base of a hydrotheca.

Locality.—Station 214, south of the Philippines; lat. 4° 33′ N., long. 127° 6′ E.; depth, 500 fathoms.

Sertularia geniculata is a very slender, perfectly hyaline form. The collection contains but a single example, which is less than an inch in height, but as the specimen is fragmentary and has lost its hydrorhizal extremity, no assertion can be made as to the height which the species may naturally attain. It is probable, however, that the perfect colony does not much exceed in size the portion which has been preserved.

The internodes, which are nearly twice as long as the very deep, narrow hydrothecæ, become wider towards their distal ends, thus adding to the knee-like form of the joints.

The hydrothecæ, for some distance below the orifice, are marked by parallel, transverse striæ, and the orifice itself is crowned by an exceedingly delicate, four-valved, membranous operculum, so delicate indeed that it was only in a few of the hydrothecæ that it was sufficiently well preserved to allow of demonstration.

Just within the orifice may be seen in optical section two broad, conical projections of the chitinous walls, one on the epicauline, and the other on the apocauline side of the hydrotheca. It is not improbable that in the living animal they give attachment to contractile bands employed in the closing of the operculum.

Sertularia cylindritheca, n. sp. (Pl. XXIX. figs. 1, 1*a*).

Trophosome.—Main stem monosiphonic, not divided into branches, but set with pinnately disposed, alternate ramuli. Hydrothecæ borne both by stem and pinnæ, one only on every internode, alternate, cylindrical, adnate by the base to the hydrocaulus, and free for nearly the whole of their epicauline side, margin with four low cusps.

Gonosome not present.

Locality.—Off Bahia.

Sertularia cylindritheca, though destitute of fasciculation, is a strong-growing, rather rigid form. The specimen in the collection is fragmentary, and though broken away

from its hydrorhizal end has a height of four inches. From the main stem, which is simple, are emitted alternate pinnæ, which are themselves occasionally branched. The hydrothecæ are absolutely cylindrical, and arise close to the distal ends of the internodes. They have but a very small portion of their epicauline side adnate to the internode, and from the fact of this portion being nearly in the same plane with the true base the hydrothecæ have the appearance of being entirely free from the base to the summit. That the attached portion, however, must be regarded as consisting not only of the true base but of a portion of the epicauline side, will be apparent from a comparison with such species as *Sertularia echinocarpa* and *Sertularia geniculata* (Pl. XXVIII.), and it will thus be seen that the present species offers no real exception to the general character of the family. The four-cusped margin of the hydrotheca distinguishes this species from *Sertularia integritheca*, which it closely resembles in almost every other respect, and with which it was associated in the contents of the dredge.

Sertularia integritheca, n. sp. (Pl. XXIX. figs. 2, 2*a*).

Trophosome.—Hydrocaulus consisting of unbranched, monosiphonic stems, set with pinnately disposed alternate ramuli. Hydrothecæ borne both by stems and ramuli, one on every internode, alternate, exactly cylindrical, each springing from the hydrocaulus by its base, and then free for nearly its entire height, orifice circular and entire.

Gonosome not present.

Locality.—Off Bahia.

Sertularia integra is a large and strong-growing species, chiefly characterised by its absolutely cylindrical hydrothecæ, whose perfectly circular and entire orifice occupies the whole summit of the hydrotheca.

The stems spring at intervals from a creeping, tubular filament, and attain a height of about four inches. They are rather thick, monosiphonic throughout, not dividing into branches, but set along nearly their entire length with alternate pinnæ.

The hydrothecæ are each attached to the hydrocaulus by its base and by a very small extent of the epicauline side. In this character they entirely agree with the preceding species (*Sertularia cylindritheca*). The joints which separate the internodes occur just above the hydrothecæ. They are sufficiently distinct towards the distal ends of the ramuli, but in the more proximal or older parts they frequently become indistinct or even obliterated.

The species is a member of the rich Hydroid fauna of Bahia, but though the specimens obtained were finely developed they were quite destitute of gonosome.

Sertularia articulata, n. sp. (Pl. XXIX. figs. 3, 3*a*).

Trophosome.—Hydrocaulus irregularly branched, slender, divided into equal internodes by strongly marked transverse joints, every internode carrying a hydrotheca close to its distal end. Hydrothecæ alternate, adnate to the internodes for somewhat more than half their height, the free portion diverging at a high angle and very slightly tapering towards the orifice, which at its apocauline margin has a deep sinus bounded by two strong lateral cusps.

Gonosome not present.

Locality.—Station 149D, Royal Sound, Kerguelen Island; depth, 28 to 60 fathoms.

The most striking character in this delicate species is found in the depth and distinctness of the joints, a peculiarity which gives to the hydrocaulus a decidedly articulated appearance, the distal end of each internode being slightly wider than the proximal end of the internode which rests upon it. The specimen contained in the collection is a mere fragment, destitute not only of gonosome but of hydrorhizal extremity.

In some respects the present species approaches *Sertularia johnstoni*, Gray. From this, however, which is a New Zealand species, it differs in the form of its hydrothecæ, which in *Sertularia johnstoni* are slightly tumid below, as well as in their position, which in *Sertularia johnstoni* is near the middle of the internode instead of being as in the present species close to the distal end.[1] The jointing of the hydrocaulus, though very distinct in *Sertularia johnstoni*, does not in that species present the well-defined character which we meet with here as the result of the difference of diameter in the extremities of the two internodes where they unite to form the joint.

Sertularia operculata, Linnæus (Pl. XXX. figs. 1, 1*a*).

Sertularia operculata, Linn., Syst. Nat. (Gmel.), p. 3844.
„ „ Lamk., Anim. sans Vert. (ed. 2), t. ii. p. 144.
„ „ Hincks, Brit. Hydroid Zooph., p. 263, pl. liv.

Trophosome.—Hydrocaulus monosiphonic, slender, profusely branched, ramification dichotomous or subdichotomous. Hydrothecæ exactly opposite, adnate to the hydrocaulus by somewhat more than half their height, gently curving outwards, opening by a very oblique orifice which occupies the greater part of the epicauline side of the free portion of the hydrotheca, apocauline side of orifice with a deep sinus, each of whose sides is produced into a strong, sharp tooth.

Gonosome.—Gonangia elongate, oviform, tapering below to a short and narrow

[1] *Journ. Linn. Soc. Lond.* (Zool.), vol. xii. p. 261.

peduncle, summit truncated and occupied by the circular, entire orifice, which is closed by a chitinous lid.

Locality.—Station 304, Port Otway, Patagonia ; lat. 46° 53′ 15″ S., long. 75° 12′ W.; depth, 45 fathoms.

I do not hesitate to refer the Hydroid here described to the *Sertularia operculata*, Linn., an abundant species of the European seas.

The orifice of the hydrotheca extends from the apocauline wall of the divergent distal end almost to the point where the hydrotheca ceases to be adnate to the hydrocaulus. The apocauline margin of the orifice presents a deep notch or sinus, each side of which is produced into a sharp tooth-like lobe. This account of the hydrothecal margin differs somewhat from the descriptions hitherto given of this part, as seen in European specimens, descriptions which seem to be based on incorrect interpretation of the perspective under which the object usually presents itself when viewed beneath the microscope.

The Challenger specimens have a height of about four inches. They were dredged off Patagonia from a floor of green sand, with a depth of 45 fathoms. Another station is thus added to the already determined wide geographical distribution of the species.

Sertularia abietina, Linnæus (Pl. XXVII. figs. 2, 2*a*).

Sertularia abietina, Linn., Syst. Nat. (Gmel.), p. 3845.
„ „ Lamk., Anim. sans Vert. (ed. 2), t. ii. p. 131.
„ „ Hincks, Brit. Hydroid Zooph., p. 266, pl. lv.

Trophosome.—Main stem monosiphonic, set for nearly its entire length with pinnately disposed, rather close set, alternate ramuli, and often emitting branches which are similarly set with pinnæ so as to repeat in all respects the habit of the stem from which they spring. Hydrothecæ subalternate, two borne on each internode, adnate to the hydrocaulus for about one-third of their height, flask-shaped, ventricose below, then narrowing into a tubular neck which diverges strongly from the internode, and terminates in an entire circular orifice with slightly everted margin.

Gonosome.—Gonangia subsessile, springing from the front of the pinnæ, each from a point close to the base of a hydrotheca, ovate, with a slightly elevated, circular and entire orifice.[1]

Locality.—Station 48, off Halifax, Nova Scotia ; lat. 43° 4′ N., long. 64° 5′ W.; depth, 51 fathoms.

The specimens of this Hydroid obtained by the Challenger were dredged off the Atlantic shores of North America. They differ in no essential point from the form as it

[1] No gonangia were present in the Challenger specimens.

occurs on the British coast, where it is perhaps the most abundant of all the large Hydroids there found, while it is also one of the most widely distributed throughout the North Atlantic region. It is of rather robust habit, and is at once distinguished from every other species by its flask-shaped hydrothecæ, with their attenuated diverging necks.

Diphasia, Agassiz.

Sertularia, Linn. (in part).
Diphasia, Agassiz, Nat. Hist. U.S., vol. iv. p. 355.

Generic Character. *Trophosome.*—Colony dendritic; hydrocaulus divided by equidistant joints into internodes, each of which carries a pair of hydrothecæ. Hydrothecæ sessile, more or less adnate by their walls to the hydrocaulus, distichous, opposite or subopposite, with entire or emarginate rim, and with a lid-like operculum formed by a single valve.

Gonosome.—Gonophores adelocodonic. Gonangia in female colonies crowned by a marsupial chamber enclosed within chitinous walls, gonangia in male destitute of marsupium.

The genus *Diphasia* was founded by Agassiz for the purpose of including species hitherto placed in *Sertularia*, but which differ from the true *Sertulariæ* in the gonangia of the female colony carrying on their summit a special chamber enclosed within lobe-like extensions of the chitinous walls of the proper gonangium. Into this chamber the ova are at an early stage expelled from the gonangium in order to undergo further development before the escape of the embryo into the surrounding water. No marsupium is present in the male.[1]

The hydrothecæ are provided with a peculiar membranous lid, which springs by a hinge-like joint from one point of the rim, and forms when depressed a transverse septum just within the margin.

Diphasia pinaster (Ellis and Solander) (Pl. XXX. figs. 2, 2*a*, 2*b*, 2*c*).

Sertularia pinaster, Ellis and Solander, Zooph., p. 55, pl. vi.
Diphasia pinaster, Agassiz, Nat. Hist. United States, vol. iv. p. 355.
„ „ Hincks, Brit. Hydroid Zooph., vol. i. p. 252, pl. l. fig. 1.

Trophosome.—Stem monosiphonic, unbranched, set with alternate pinnæ. Hydrothecæ borne both by stem and pinnæ, subopposite, cylindrical, adnate to the hydrocaulus for about two-thirds of their height, then diverging at a wide angle; orifice oblique, crowned by a membranous valve-like lid.

[1] The "acrocyst" which in certain species of *Sertularia* (*e.g. Sertularia pumila*) is formed on the summit of the female gonangium, differs from the marsupium of *Dipharia* in the fact of its being never included within an external chamber bounded by chitinous walls.

Gonosome.—Gonangia shortly pedunculate, borne by the pinnæ, each from a point just below a hydrotheca; male gonangia urn-shaped, crowned by a conical projection which carries the orifice on its summit, and is surrounded by four symmetrically disposed flattened spines; female gonangia obovate, crowned by four spinous valves which enclose the marsupial chamber.

Locality.—Station 75, near the Azores; lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms.

Though the specimens obtained by the Challenger differ somewhat from the *Diphasia pinaster* of the European seas, especially in their shorter and rather more rigid pinnæ, and in the more elongated form of their female gonangia, I have little hesitation in referring them to this species.

Diphasia pinaster is a well-marked species, and when the pinnæ are laden with their large and elegantly formed gonangia constitutes a striking and beautiful object. The specimens obtained by the Challenger have a height of four or five inches. The hydrothecæ are decidedly subopposite in the pinnæ, but more nearly opposite in the stem. The orifice is oblique, having a wide sinus at its epicauline side and is provided with a thin membranous lid which is hinged on to the bottom of the marginal sinus. When depressed this lid lies within the orifice, and then stretches transversely across the cavity of the hydrotheca. No distinct joints are present in any part of the stem or pinnæ.

The male gonangium has the small circular orifice raised on the summit of a conical projection of the roof, and this is surrounded by four symmetrically placed strong spines, which are laterally compressed, and have their bases extended downwards as four keel-shaped ridges along the walls of the gonangium.

The female gonangia with the marsupium are nearly twice the length of the male. The marsupial chamber is of about the same height as that of the gonangium proper. The four valves by which the marsupium is enclosed have a row of two or three strong spines extending along the mesial line of each.

The specimens obtained by the Challenger were dredged from a depth of 450 fathoms, and form part of the rich Hydroid fauna which the region of the Azores has yielded to the dredge.

Thuiaria, Fleming.

Thuiaria, Fleming, British Animals, p. 545.

Generic Character. Trophosome.—Colony dendritic; hydrocaulus divided by well-marked joints at regular or irregular intervals into internodes, each of which carries many hydrothecæ. Hydrothecæ distichous, opposite or alternate, sessile, adnate by a greater or less extent of their walls to the hydrocaulus, margin of orifice entire or variously cleft or dentate. Hydranth with conical hypostome.

Gonosome.—Gonophores adelocodonic; gonangia springing from one side of the hydrocaulus, no marsupium present in either sex.

The genus *Thuiaria* was separated by Fleming from *Sertularia* on grounds derived from the supposed immersion of the hydrothecæ in the hydrocaulus, instead of their being as in *Sertularia* merely adnate to its surface.

The character, however, thus relied on has really no existence. The hydrothecæ of the species separated on this ground from *Sertularia* are not more deeply immersed in the hydrocaulus than are the hydrothecæ of most species of *Sertularia*, and the appearance of immersion is given by the greater extent in which the walls of the hydrothecæ are in some species adnate to the hydrocaulus, while even this is never greater than what occurs in many species which are allowed to remain in *Sertularia*.

There can, however, be no doubt that the general aspect of *Thuiaria* contrasts strongly with that of the species with which it had been previously associated, but the true source of this is to be found in a character very different from that of the supposed immersion of the hydrothecæ in the hydrocaulus.

In the species of *Sertularia* with opposite hydrothecæ every pair of hydrothecæ has an internode of the stem to itself, being separated on each side from the adjacent pair by a joint. In those species in which the hydrothecæ are alternate the internodes carry each, sometimes two alternate hydrothecæ, but most frequently a single one. In these various cases the intervals between the joints are constant, every internode in the same colony carrying the same number of hydrotheca.

In *Thuiaria* it is different. The internodes here always carry many hydrothecæ, whether in pairs or alternate. The joints moreover are in most cases so decided as to form well-marked constrictions in the stem, a character which in combination with the length of the internodes confers upon *Thuiaria* an aspect very striking and distinctive. Moreover, the internodes are often of variable length, the number of hydrothecæ carried by each frequently varying in different parts of the same colony.

It is true that in *Sertularia* we may sometimes meet with examples in which for a considerable length of the stem no joints are apparent. This, however, is a secondary condition resulting from the effacement in the older parts of the hydrocaulus of the joints which had been present in an earlier period;[1] while in *Thuiaria* the very well marked joints are at all times separated from one another by intervening series of many hydrothecæ.

If the diagnostic characters of *Thuiaria* be such as are here contended for, some species which had been hitherto referred to *Sertularia* must be removed to *Thuiaria*. *Sertularia cupressina*, Linn., and *Sertularia argentea*, Ellis and Solander, will thus find their places in *Thuiaria*. Indeed there is not a single character which would justify the inclusion of these Hydroids in *Sertularia* rather than in *Thuiaria*.

[1] I believe that the *Thuiaria sertularoides* of The Hydroids of the Gulf Stream is a case of this kind, and that the species is truly a *Sertularia* which, on account of the effacement of the joints, I have erroneously referred to *Thuiaria*.

Thuiaria quadridens, n. sp. (Pl. XXXI. figs. 2, 2*a*).

Trophosome.—Stem monosiphonic, pinnately branched, joints at irregular intervals. Hydrothecæ alternate, deep, subcylindrical, adnate to the internode for somewhat more than half their height, and then diverging at a rather high angle; margin divided into four teeth, two of which are narrow and situated at the epicauline side, and two broader at the apocauline.

Gonosome not present.

Locality.—Station 314, between Cape Virgins and the Falkland Islands; lat. 51° 35′ S., long. 65° 39′ W.; depth, 70 fathoms.

Thuiaria quadridens was dredged from the same ground with *Sertularia implexa*. It is a rather slender form of much elegance, and attains a height of nearly two inches.

Thuiaria pharmacopola, n. sp. (Pl. XXXI. figs. 1, 1*a*, 1*b*, 1*c*, 1*d*).

Trophosome.—Stem strongly fascicled below, becoming monosiphonic distally, sparingly branched, set with alternately disposed pinnæ. Hydrothecæ opposite, adnate to the hydrocaulus for nearly their entire height, cylindrical, deep, terminating in an oblique orifice whose apocauline margin forms an acute tooth.

Gonosome.—Gonangia borne upon the front of the pinnæ, each springing from a point in the interval between two pairs of hydrothecæ, urniform, with the roof raised as a conical projection which carries the circular even orifice on its apex, and is surrounded by about six compressed spines.

Locality.—Station 75, off the Azores; lat. 38° 38′ 0″ N., long. 28° 28′ 30″ W.; depth, 450 fathoms.

Thuiaria pharmacopola is a large and beautiful species. It grows to a height of upwards of six inches, while the pinnæ, which are rather closely set, may attain a length of more than one inch. The stem towards its base is thick and densely fascicled, but becomes monosiphonic towards its summit. The hydrothecæ composing each pair in the pinnæ are approximate, but not connate. The intervals which separate the pairs from one another are short, and joints occur here and there in the pinnæ, but at long and very uncertain intervals.

A transverse section of the stem near its base (fig. 1*c*) presents an areolar structure resulting from its fascicled composition, the component tubes being very thick-walled and inseparably adnate to one another. Such a section affords a good illustration of the difference between the more common forms of fasciculation and the true perisiphonic fasciculation of the Perisiphonidæ.

Hydrothecæ are also borne by the stem, but these are smaller than the hydrothecæ of the pinnæ, and those of each pair are separated from one another by a much wider interval than in the pinnæ.

The gonangia (fig. 1*b*) have the form of certain antique jars. They are perfectly symmetrical, and the circle of compressed spines with which they are ornamented round the base of the neck gives further force to this comparison and adds much to the attractiveness and singularity of their form. They occur in a closely set row along the front of each pinna, and by the quaintness of their shape and the regularity of their arrangement they recall the rows of jars which may be still occasionally seen in old continental towns on the shelves of apothecaries' shops. The name which I have assigned to the species has been suggested by this comparison.

Thuiaria cupressina, Linnæus, sp. (Pl. XXXII. figs. 1, 1*a*, 1*b*, 1*c*).

Sertularia cupressina, Linn., Syst. Nat. (Gmel.), p. 3847.
„ „ Lamk., Anim. sans Vert., ed. 2, vol. ii. p. 144.
„ „ Hincks, Brit. Hydroid Zooph., p. 270, pl. lvii.

Trophosome.—Main stem unbranched, monosiphonic, jointed at uncertain intervals, set with alternate, dichotomously divided pinnæ, which are provided with well-marked joints, one of which always occurs just below every bifurcation, and another just above it on one of its two branches, while others occur at distant intervals on the branches. Hydrothecæ subalternate, deep, conical, adnate to the hydrocaulus for about half their height, then divergent from the axis, and terminating in a narrow, two-lipped orifice.

Gonosome.—Gonangia springing each from a point just below the base of a hydrotheca, obconical, terminating distally in a short, conical process, which carries the even, circular orifice, and is flanked by two short spines.[1]

Locality.—Station 48, off Halifax, Nova Scotia; lat. 43° 4′ N., long. 64° 5′ W.; depth, 51 fathoms; bottom, rock.

Though the Hydroid here described differs in some minor points from the forms occurring on the European coasts, I have no hesitation in referring it to the "Sea-Cypress" of Ellis, the *Sertularia cupressina* of Linnæus and of subsequent authors, a species common on many parts of the British coast.

I have already insisted on the necessity of removing this species, as well as the nearly allied *Sertularia argentea* of authors, from *Sertularia*, and allocating them to *Thuiaria*, with which in all the essential points of this genus they entirely agree.

Thuiaria cupressina is an interesting and beautiful species. The specimen in the

[1] No gonosome was present in the specimen. The description is from the condition of this part in European examples.

collection has a height of about seven inches, and consists of a smooth, cylindrical, monosiphonic stem, set for the greater part of its length with delicate, alternate, pinnately disposed ramuli, each springing by a distinct joint from the summit of a well-developed cladophore, and usually presenting two, sometimes three or four bifurcations. Every bifurcation is immediately preceded by a very distinct joint, while a similar joint occurs, in one of the two branches of the bifurcation, close to the origin of the branch. Joints also occur at distant intervals on the branches. The stem carries a hydrotheca in the axil of every pinna, and is provided with very well marked joints at distant but uncertain intervals.

The margin of the hydrothecal orifice is deeply cleft, and the orifice thus becomes bounded by two triangular lips, which give to the summit of the hydrotheca the form of a mitre. The perisarc of the stem is thick and of a dark-brown colour, that of the pinnæ is very thin and transparent, and nearly colourless. In many of the ramuli the soft parts were well preserved and allowed of a good view of the cœnosarc and hydranths.

Thuiaria vincta, n. sp. (Pl. XXXII. figs. 2, 2*a*).

Trophosome.—Stem monosiphonic, simple, set with pinnately disposed, equidistant, alternate ramuli, which are divided into internodes by constrictions at uncertain intervals. Hydrothecæ borne both by stem and pinnæ, closely set on the pinnæ, alternate, nearly cylindrical, wide, adnate to the hydrocaulus for nearly their entire height, those of opposite sides bound to one another by strong chitinous bands formed by thickenings of the intervening perisarc, orifice circular and entire.

Gonosome not present.

Locality.—Station 186, Flinders Passage; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms.

The only specimen of this curious form contained in the collection is a fragment about an inch and a half in height, which scarcely allows of a satisfactory estimate of the size and habit of the colony. It is very regularly pinnate, and both stem and pinnæ carry alternate hydrothecæ which in the pinnæ are closely set.

Its most remarkable feature consists in thickenings of the perisarc of the hydrocaulus, which in the form of strong bands stretch from the proximal angle of the epicauline side of every hydrotheca to the opposed wall of a hydrotheca of the opposite side, thus giving to the hydrothecæ the appearance of being bound together by strong chitinous bands. The angle to which one end of each band is attached presents a knob-like thickening of its chitinous walls.

Thuiaria pectinata, n. sp. (Pl. XXXIII. figs. 1, 1*a*).

Trophosome.—Stem unbranched, monosiphonic, set with equidistant, opposite pinnæ, pinnæ usually with a joint occurring at no definite distance from the base. Hydrothecæ borne both by stem and pinnæ, opposite on stem, subopposite on pinnæ, conical, deep, adnate to the hydrocaulus for their entire height, and thence prolonged for a short distance by a free, thin, membranous extension of their walls.

Gonosome not present.

Locality.—Simon's Bay, Cape of Good Hope.

Thuiaria pectinata is a very elegant little species, attaining a height of between two and three inches. It is of a rather rigid habit, and in its exactly opposite pinnæ it presents a feature which is as unusual as it is striking.

The pairs of pinnæ are situated at equal distances, being separated from one another by three pairs of opposite hydrothecæ.

The hydrothecæ proper are entirely adnate to the hydrocaulus, but their walls are continued for a short distance in the form of a free, very thin, membranous tube, which, however, is not always preserved in the specimen.

The hydrothecæ are exactly distichous, and follow one another at very short intervals.

Thuiaria hyalina, n. sp. (Pl. XXXIII. figs. 2, 2*a*).

Trophosome.—Stem fascicled, sending off pinnately disposed, alternate ramuli, whose perisarc is colourless and transparent. Hydrothecæ borne both by stem and pinnæ, cylindrical, slightly tumid below, adnate to the hydrocaulus for their entire height, and gently curving away from the axis; orifice with four indistinct cusps.

Gonosome not present.

Locality.—Station 126, south of Pernambuco; lat. 10° 46′ S., long. 36° 2′ W.; depth, 770 fathoms.

The specimen of *Thuiaria hyalina* contained in the collection is but fragmentary, and has a height of upwards of three inches. The stem is strongly fascicled below, but becomes monosiphonic towards its distal end. It carries along its length short, simple ramuli, with a regularly pinnate disposition.

The ramuli and the monosiphonic portions of the stem are perfectly transparent and colourless, and allow a good view to be obtained of their contents. These, in some parts of the specimen, have been well preserved, and afford evidence of the remarkable fact that in this species the hydranths are but imperfectly retractile. The greater part of the body

of the hydranth is fixed within the hydrotheca by bands which stretch from it to the walls of the hydrotheca, and it is only the distal end of the hydranth which admits of retraction and extension. The tentacular crown, even in its state of extreme contraction, is incapable of being withdrawn into the cavity of the hydrotheca, and, notwithstanding the complete development of the hydrothecæ, the hydranths derive almost as little protection from them as those of *Halecium* do from the hydrothecæ in that genus, where these receptacles are rudimental. However extensile may be the bands which stretch from the body of the hydranth to the walls of the hydrotheca, it would seem that they operate in fixing the body of the hydranth and thus preventing the complete retraction of the hydranth within the hydrotheca. A condition entirely similar to this occurs in *Sertularia exserta*. See above, p. 56.

The depth of 770 fathoms from which *Thuiaria hyalina* was dredged adds to the interest of the species, and the transparency and absence of colour in its perisarc has probably some relation with the great depth of its habitat.

Desmoscyphus, Allman.

Desmoscyphus, Allman, Journ. Linn. Soc. Lond. (Zool.), vol. xii.

Generic Character. Trophosome.—Colony dendritic; hydrocaulus divided by joints into internodes, each internode corresponding to one or more pairs of hydrothecæ. Hydrothecæ of the ramuli all brought to one side of the ramulus and adnate to it by their epicauline walls, adnate also or in close apposition to one another by their opposed sides.

Gonosome.—Gonophores adelocodonic, gonangia destitute of marsupium.

The genus *Desmoscyphus* was originally constituted for a Hydroid from New Zealand. In the extent to which the hydrothecæ are adnate to the hydrocaulus it agrees with many species of *Thuiaria*, while another point of agreement with that genus will be found in the fact that in some parts of the colony a single internode may carry many hydrothecæ. From *Thuiaria*, however, it is obviously separated by the hydrothecæ on the ramuli being all brought to one side of the ramulus, where they become in almost every instance adnate to one another in pairs along their opposed sides. In *Desmoscyphus pectinatus*, one of the species obtained by the Challenger, while the hydrothecæ are closely approximate, their walls have not actually coalesced with one another, though the hydrothecæ present the essential character of the genus in being all brought to one side of the branch, instead of being distichous as in *Thuiaria* and *Sertularia*.

It is only in the branches that the characteristic condition of the hydrothecæ is constant. In the main stem, especially towards its proximal end, the hydrothecæ may recede from one another and ultimately become disposed in two opposite series, separated as in *Thuiaria* and *Sertularia* by the entire width of the stem.

Desmoscyphus pectinatus, n. sp. (Pl. XXXIV. figs. 1, 1*a*, 1*b*).

Trophosome.—Main stem monosiphonic, simple, carrying alternate pinnately disposed ramuli along nearly its entire length. Hydrothecæ of pinnæ exactly opposite, those of each pair closely approximate but not connate, adnate to the internode for somewhat more than half their height, and diverging towards their summits at a low angle; those of the stem alternate, distichous, adnate to the internode for nearly their entire height; all the hydrothecæ tapering towards the summit, where they terminate in a two-lipped orifice.

Gonosome not present.

Locality.—Station 162, off East Moncœur Island, Bass Strait; depth, 38 to 40 fathoms.

Also off Bahia.

This is a small but elegant species. The largest of the examples contained in the collection had a height of about two inches. The hydrothecæ are carried both by the stem and pinnæ. While those of the pinnæ are opposite and closely approximate by their opposed sides, those of the stem are alternate and widely separate. The orifice is cloven so as to present two lips, an anterior smaller and a posterior larger. The interval between the lips would seem capable of being closed in the living state by two valve-like membranes of extreme tenuity, some shreds of which were occasionally retained in the specimens.

The joints of the pinnæ are usually distinct between each pair of hydrothecæ. In some specimens, however, they were here and there nearly or quite obliterated.

The stem is divided by well-marked equidistant joints into regular internodes, each internode carrying one, or in some cases two, pinnæ. Three hydrothecæ occupy the interval between every two pinnæ on each side.

The hydrothecæ of the pinnæ, though all brought to one side of their supporting internodes and closely approximate, are not exactly connate. This slight departure, however, from absolute coalescence affords no grounds for regarding the species as other than a true *Desmoscyphus*. The close approximation of the hydrothecæ, and the fact of their being all brought to one side of the internode, are decisive in favour of its allocation in the genus *Desmoscyphus*.

Desmoscyphus pectinatus was obtained from two widely separated localities, Bass Strait and the region off Bahia.

Desmoscyphus gracilis, n. sp. (Pl. XXXIV. figs. 2, 2*a*, 2*b*, 2*c*).

Trophosome.—Stem monosiphonic, not divided into branches, springing at intervals from a creeping, filiform stolon, gently undulated, sending off regular, pinnately disposed,

alternate ramuli, every ramulus supported by a rather long cladophore, and having its proximal internode united to the next by a very oblique, splice-like joint. Hydrothecæ borne both by main stem and pinnæ; those of the pinnæ in distant pairs, exactly opposite, adnate to one another along their opposed sides, then strongly divergent, and terminating in an orifice with a broad cusp on each side; apocauline wall with a strong, inflected fold at somewhat more than half its height from the base; hydrothecæ of main stem subopposite in distant pairs, with a solitary hydrotheca in the axil of every pinna; those of each pair not adnate to one another by their opposed sides.

Gonosome not present.

Locality.—Station 36, off Bermuda; depth, 30 fathoms.

Desmoscyphus gracilis is a small and elegant species. It attains a height of about two inches, and its slender, undivided stems, with their regular, pinnately disposed ramuli, give to it a symmetrical and graceful habit. The pinnæ are divided by distinct joints into well-defined, rather long internodes, each of which carries close to its distal end a pair of connate hydrothecæ. The deep inflexion of the apocauline wall of the hydrotheca forms in the interior of its cavity a prominent, transverse ridge. The pinnæ are supported on rather long cladophores, and the proximal internode, which is cylindrical and destitute of hydrothecæ, is united to the next by a very oblique, overlapping, splice-like joint, the opposed sides of these two internodes being here cut away to an acute point. The union between the internodes is weaker at this joint than at any other, and the pinna here becomes easily separated from the proximal internode, which remains still attached to the cladophore, its sharp, distal end giving it the appearance of a rigid spine. Many of the pinnæ, towards the hydrorhizal end of the stem, have in the greater number of the specimens become detached at this joint, and the stem has then the appearance of being, for some distance from its base, armed on each side with a series of sharp spines.

The main stem is also divided into distinct internodes by joints which are situated one just below every pinna. The hydrothecæ of the stem are not as in the pinnæ exactly opposite. They are subopposite, and those of each pair, instead of being adnate to one another as in the pinnæ, are separated by a considerable interval.

Desmoscyphus obliquus, n. sp. (Pl. XXXIV. figs. 3, 3*a*).

Trophosome.—Stem monosiphonic, unbranched, divided into short internodes, each of which sends off a pinna from alternate sides; pinnæ composed of well-defined internodes, each carrying a pair of obliquely opposite hydrothecæ. Hydrothecæ of pinnæ wide, adnate to internode for nearly their entire height, and with their free ends slightly divergent; margin with a broad cusp on each side.

Gonosome not present.

Localities.—Off Somerset, Cape York, Torres Strait; depth, 8 to 12 fathoms. Bahia; depth, 10 to 20 fathoms.

This is a graceful plumose form, attaining a height of about three inches, and exceptional among the species of *Desmoscyphus* in having the hydrothecæ which compose each pair in the pinnæ not strictly opposite, but so disposed that a line joining the centres of both will be oblique to the axis of the pinna.

While the hydrothecæ of the pinnæ, notwithstanding this obliquity, are adnate to one another by their opposed sides, those of the stem are widely separate. Here they are alternate and smaller than those of the pinnæ, while every internode carries two on one side and one on the other; one which is somewhat smaller than the others being always borne in the axil of a pinna.

Desmoscyphus obliqua was dredged from widely separated localities—Torres Strait, where it occurred at a depth of from 8 to 12 fathoms, and off Bahia, where specimens were brought up from depths of 10 to 20 fathoms.

Desmoscyphus acanthocarpus, n. sp. (Pl. XXXV. figs. 2, 2*a*, 2*b*, 2*c*).

Trophosome.—Stem monosiphonic, unbranched, carrying alternate pinnæ; stem and pinnæ composed of well-defined internodes, every internode carrying a pair of opposite hydrothecæ which are connate in the pinnæ but disjunct towards the proximal end of the stem. Hydrothecæ deep, tubular, adnate to the front of the internode for nearly their entire height; margin of orifice having at its epicauline side a wide sinus, the edge of which supports a thin, membranous, hood-shaped operculum which arches over the orifice.

Gonosome.—Gonangia elongated pyriform, with the axis slightly curved, springing with an alternate disposition each by a very short peduncle from an internode of the main stem just below the base of a hydrotheca, terminating distally in an even circular orifice, and thickly set with minute spines.

Locality.—Off Bahia; depth, 10 to 20 fathoms.

Desmoscyphus acanthocarpus is a curious and interesting species. The hydrothecæ along the entire length of the pinnately disposed ramuli are all brought to one side of the ramulus, and are here connate to one another for nearly their entire height. Those which are borne by the stem are similarly connate towards the distal end of the stem, but towards the proximal end they become disjunct and more and more widely separated from one another, until ultimately they lie in two exactly opposite marginal series. The stem for some distance from its hydrorhizal end is destitute of hydrothecæ, and here forms a

cylindrical peduncle to which the hydrotheca-bearing portion is attached by a very oblique splint-like joint (fig. 2*c*).

The hood-like roof which arches over the orifice of the hydrotheca is present in all the hydrothecæ, whether of the pinnæ or of the stem, and consists of a very thin, transparent, chitinous membrane. So delicate is it that it is easily torn away, and it was only in some cases that it was sufficiently perfect to enable its form to be satisfactorily determined.

The gonangia are beautiful objects and constitute a striking feature of the species. They are relatively narrow, but have a length which is equal to about twice that of an internode of the stem. With their axis gently curved they gradually taper from a rounded base towards the terminal circular orifice. They are thickly set from base to summit with minute spines, whose points are directed towards the summit of the gonangium. When the stem is viewed in profile the gonangia, though strictly distichous in their origin, are seen to be for the most part directed with a secund disposition towards one side of the stem.

The largest example of *Desmoscyphus acanthocarpus* in the collection measured about two inches in height. The species is a member of the rich Hydroid fauna occurring off the coast of Bahia.

Hypopyxis, n. gen.

Name from ὑπό, under, and πυξίς, a box, in allusion to the cup-like appendages which lie below the hydrothecæ.

Generic Character. Trophosome.—Hydrocaulus divided by well-marked joints into internodes, each carrying numerous pairs of hydrothecæ. Hydrothecæ opposite, adnate to one another by their opposed sides, each having attached to its base two minute cup-shaped appendages.

Gonosome.—Gonangia destitute of marsupium, springing from the hydrocaulus in the intervals of the pairs of hydrothecæ.

The genus *Hypopyxis* has in its opposite and connate hydrothecæ close relations with *Desmoscyphus*. From *Desmoscyphus*, however, it is distinguished by the presence of the cup-like appendages at the base of the hydrothecæ.

That these appendages must be regarded as sarcothecæ can scarcely be doubted, and *Hypopyxis* will thus afford an additional example of the very exceptional occurrence of these bodies in genera not referable to the Plumularinæ.

Hypopyxis labrosa, n. sp. (Pl. XXXV. figs. 1, 1*a*).

Trophosome.—Stem simple or very sparingly branched, monosiphonic, and set with pinnately disposed, alternate ramuli, which are divided by very oblique joints into

internodes of various lengths. Hydrothecæ borne both by stem and pinnæ, deep, tumid below, slightly narrowing upwards, those of each pair adnate to one another for nearly two-thirds of the height of their opposed sides, then diverging and terminating in a circular orifice which is directed laterally, and is surrounded by a thin, membranous, expanded lip.

Gonosome.—Gonangia fusiform, contracting below into a very short, narrow peduncle, and terminating distally in an even circular orifice.

Locality.—Station 163A, off Twofold Bay, Australia; depth, 150 fathoms.

Hypopyxis labrosa attains a height of about four inches. The pinnæ are given off at a moderate distance from one another along nearly the whole length of the stem. Each is supported on a short cladophore which springs from the side of the stem between two pairs of hydrothecæ. Every pinna commences with a short proximal segment which is destitute of hydrothecæ, and is united to the remainder of the pinna by a very oblique splice-like joint. The orifice of the hydrotheca is surrounded by a membranous expanded lip. This is very thin, and would seem to be easily lacerated and destroyed, for it was only occasionally preserved in a sufficiently perfect state in the specimens examined. The joints which separate the internodes of the pinnæ from one another are very oblique and splice-like, and the number of pairs of hydrothecæ borne by each internode varies from five to seven, or perhaps more. The hydrothecæ are all brought to one side (the front) of the internode, the opposite side remaining uncovered.

The cup-like appendages of the base of the hydrothecæ have, when viewed in front, the form of a wide bell, but when viewed laterally are seen to be compressed. They measure about one-sixth of the height of the hydrotheca. Each hydrotheca carries two, one on the front of its base near its junction with the opposite hydrotheca, the other on a point of its base which lies diametrically opposite to this.

The gonangia spring from the front of the pinna in the intervals between the pairs of hydrothecæ, and correspond in height to about three pairs of hydrothecæ.

Staurotheca, n. gen.

Name from σταυρὸς, a cross, and θήκη, a receptacle, in allusion to the decussation of the hydrothecæ.

Generic Character. Trophosome.—Hydrocaulus carrying opposite hydrothecæ, which are arranged in decussating pairs.

Gonosome.—Gonangia simple capsules springing from the hydrocaulus, and destitute of marsupium.

The genus *Staurotheca* has close affinities with *Sertularia*, from which, however, it is distinguished by its decussating hydrothecæ. These are so disposed that the

plane passing through any one pair of hydrothecæ is at right angles with the planes which pass through the pairs at each side of it.

Staurotheca dichotoma, n. sp. (Pl. XXXVI. figs. 1, 1*a*).

Trophosome.—Stem strongly fascicled towards its proximal end, becoming monosiphonic distally, dichotomously branched in a single plane, the branches mostly extended at their distal ends by a tendril-like prolongation, which when it reaches a neighbouring branch becomes attached to it by its extremity. Hydrothecæ deep, nearly cylindrical, slightly tumid below, orifice circular, entire.

Gonosome.—Gonangia elongated ovoid, narrowing below into a short peduncle which springs from a point just below a hydrotheca, and narrowing above into a short tubular prolongation, which is terminated by the small circular orifice.

Locality.—Station 145A, off Marion Island; depth, 85 to 150 fathoms.

This is a well-marked form, with a somewhat flabelliform habit, caused by its dichotomous ramification in a single plane, with the frequent inosculations of its strong and rather rigid branches. It attains a height of about three inches. The pairs in which the hydrothecæ are grouped are not regularly separated from one another by distinct constrictions, these occurring only at distant and uncertain intervals.

The tendril-like prolongations of the branches usually terminate in a little sucker-like disc, which attaches itself to some neighbouring branch. The point of its attachment may be the walls of a hydrotheca or some part of the surface of the hydrocaulus; while in some cases the tendril was seen to have entered the orifice of a hydrotheca.

A condition closely resembling this may be seen in certain other Hydroids, as in *Dictyocladium dichotomum* of the present Report (p. 77), and in *Thuiaria persocialis*, in which the branches of the colony are frequently connected to one another by similar bonds of union.[1]

Dictyocladium, n. gen.

Name from δίκτυον, a net, and κλάδος, a branch, in allusion to the net-like disposition of the branches.

Generic Character. Trophosome.—Hydrocaulus consisting of a ramified monosiphonic tube, the branches given off in a single plane, united to one another in such a way as to form a network, and with joints at distant and unequal intervals. Hydrothecæ more or less adnate to the branches, on all sides of which they are disposed.

Gonosome.—Gonangia situated in the axils of the ramification.

[1] *Journ. Linn. Soc. Lond.* (Zool.), vol. xii. p. 271, pl. xvii. figs. 4–6.

The remarkable network formed by the branches of *Dictyocladium dichotomum*—the only known representative of the genus—confers on this Hydroid a physiognomy, one of the most distinct and striking to be found among the Calyptoblastic genera. The extent to which the hydrothecæ are adnate to the hydrocaulus, and the occurrence of joints at distant and irregular intervals, indicate an affinity with *Thuiaria*, from which, however, it differs not only in its reticulate ramification, but in the disposition of the hydrothecæ on all sides of the branches.

Dictyocladium dichotomum, n. sp. (Pl. XXXVI. figs. 2, 2*a*).

Trophosome.—Hydrocaulus profusely and dichotomously branched, with the branches united so as to form a broad, fan-shaped, angular-meshed net, a joint occurring usually at the base of one, and sometimes of both arms of the bifurcation, and also here and there on the branches at distant and indefinite intervals. Hydrothecæ tetrastichous, alternate flask-shaped, adnate for more than half their height to the branch, and with the distal end continued into a long free tubular neck, which terminates in the small, circular, even orifice.

Gonosome.—Gonangia sessile in the angles of the bifurcations, ellipsoidal, encircled by very prominent and regular annular ridges, and having the summit continued into a short conical process which carries the small circular orifice on its apex.

Locality.—Station 162, off East Moncœur Island, Bass Strait; depth, 38 to 40 fathoms.

Dictyocladium dichotomum is a very remarkable and beautiful species. The mode in which the branches become united with one another so as to form the meshes of the net is very singular. When a branch is destined to form a union of this kind its distal extremity becomes elongated into a tendril-like continuation destitute of hydrothecæ. When this meets a neighbouring branch, the end of the tendril unites with the branch, not however with any part of the surface of the branch indifferently, but, directing itself towards the orifice of a hydrotheca, it here attaches itself, its axis becoming directly continuous with that of the hydrotheca. The branches are all in the same plane, and the collection contains specimens which have a height and width of more than five inches.

Synthecium, Allman.

Synthecium, Allman, Journ. Linn. Soc. Lond. (Zool.), vol. xii. p. 265.

Generic Character. Trophosome.—Hydrocaulus divided into definite internodes, each internode carrying a pair of opposite hydrothecæ, or a single hydrotheca which alternates with those of the internodes on each side of it. Hydrothecæ adnate for a greater or less extent to the internode.

Gonosome.—Gonangia borne on peduncles which spring from within the cavity of certain hydrothecæ, where they take the place of the hydranths.

The genus *Synthecium* was originally characterised by me from a New Zealand Hydroid in the collection of Mr. Busk. It forms one of the most definitely marked generic groups among the Calyptoblastic Hydroids, and in the singular relation of the gonosome to the hydrothecæ is absolutely unique. This relation is found in the fact that the peduncles of the gonangia are enclosed each within the cavity of a hydrotheca. The cavity is completely filled by the peduncle, which thus takes the place occupied in other hydrothecæ by the hydranth, and has its cœnosarc directly continuous through the base of the hydrotheca with the cœnosarc of the stem; the hydrothecæ which thus carry gonangia differ in no respect, either in form or in position, from those which continue to exercise their normal function of giving protection to the hydranth.

To this condition we have a very interesting parallelism in the genus *Thecocladium* (p. 80), in which, as in *Synthecium*, the usual function of certain hydrothecæ becomes changed into another. Here, however, the place of the hydranth is taken, not by any part of the gonosome, but by the origin of a branch which in *Thecocladium* occupies the cavity of the hydrotheca exactly as the peduncle of the gonangium does in *Synthecium*. In *Thecocladium* the gonangia spring as usual from the side of an internode.

Since the first determined example of the genus was described under the name of *Synthecium elegans*,[1] another closely allied to this and possibly only a variety of it has been characterised as *Synthecium ramosum*.[2] To these the Challenger collection now contributes two very distinct and well-marked species, one of which differs from all the others described in the fact of its having its hydrothecæ alternate instead of opposite.

Synthecium campylocarpum, n. sp. (Pl. XXXVII. figs. 1, 1*a*, 1*b*, 1*c*).

Trophosome.—Stem simple, monosiphonic, set with pinnately disposed opposite ramuli; pinnæ divided into equal internodes by well-marked joints, every internode carrying a pair of hydrothecæ. Hydrothecæ strictly opposite, tubular, cylindrical, with circular even orifice.

Gonosome.—Gonangia (female?) pod-shaped, compressed, slightly curved towards the supporting pinna, the two wider sides carrying closely set, prominent, transverse ridges, which thin away towards the edges of the gonangium where they finally disappear. Male (?) gonangia oviform, destitute of the transverse ridges, and with the axis straight.

Locality.—Off Port Jackson; depth, 30 to 35 fathoms.

Synthecium campylocarpum presents in its trophosome little to distinguish it from *Synthecium elegans*, the first described species of this remarkable genus. The elongated,

[1] *Journ. Linn. Soc. Lond.* (Zool.), vol. xii. p. 266, pl. xv.

[2] *Ibid.*, vol. xix. p. 137, pl. xii.

somewhat curved, compressed, and pod-shaped form of the gonangia will, however, at once distinguish it. The specimens in the collection have a height of more than two inches. The main stems arise from a prostrate, branched, tubular filament, and while they are themselves unbranched are set from end to end with exactly opposite pinnæ. A joint more or less distinct exists on the stem at the distal side of every pair of pinnæ. With the exception of an occasional pair of hydrothecæ in the interval between two pinnæ, no hydrothecæ are borne by the stem. The pinnæ are given off at a very wide angle, being nearly at right angles with the stem. They are divided by deep constrictions into short equal internodes, each internode carrying a pair of exactly opposite hydrothecæ. The hydrothecæ are deep, tubular, adnate to the internode for about two-thirds of their height, and then abruptly divergent at a high angle. The orifice is perfectly circular, and its margin entirely destitute of serration.

The gonangia are usually, but not exclusively, carried by those hydrothecæ which lie near the base of the pinna. They have the appearance of being absolutely sessile on the summit of the hydrotheca. In reality they have a long peduncle which passes down through the hydrotheca and completely fills its cavity. They would seem to differ in the two sexes. Those which I regard as female (fig. 1*a*) are compressed, so as to be elliptical in transverse section, are slightly curved towards the axis of the pinna, and are very elegantly ornamented on the two broad faces by prominent, transverse, parallel ridges, which gradually thin away towards the edges, where they become finally effaced. Gonangia which differ from these in form were present in one specimen (fig. 1*b*). I regard them as those of a male colony. They are oviform, with the axes straight, and are destitute of the ridges which form a characteristic feature in the others. Both forms of gonangia open on the summit by a small, scarcely elevated, even orifice.

In one of the specimens of *Synthecium campylocarpum* in the collection no gonangia were present; but the place of a gonangium was taken by a branch which thus had its origin within the hydrotheca, from the orifice of which it protruded (fig. 1*c*). This branch carried pairs of opposite hydrothecæ, and differed in no respect from an ordinary pinna.

Though I regard this as an entirely abnormal condition, it is by no means destitute of morphological interest as repeating in *Synthecium* a feature which constitutes the essential character of *Thecocladium;* while the substitution of a typical nutritive element of the colony for a typical reproductive one is not without significance.

Synthecium has been hitherto known only as a New Zealand genus, *Synthecium elegans* being apparently an abundant and characteristic species of the New Zealand coast. The same haul of the dredge, however, which brought up *Synthecium campylocarpum* from a depth of between 30 and 35 fathoms off Port Jackson, yielded also *Synthecium alternans*, another very distinct and interesting member of the genus.

Synthecium alternans, n. sp. (Pl. XXXVII. figs. 2, 2*a*).

Trophosome.—Stem unbranched, fascicled towards the base, set with pinnately disposed, equidistant, alternate ramuli; ramuli divided into equal internodes, each of which carries a hydrotheca near its distal end. Hydrothecæ alternate, tubular, deep, adnate to the internode for about half their height, then diverging at a high angle and terminating in a circular and entire orifice.

Gonosome.—Gonangia oval, compressed, destitute of annulation, and with a terminal, scarcely elevated orifice.

Locality.—Off Port Jackson; depth, 30 to 35 fathoms.

The present species is of great interest as affording an instance of the characteristic synthecial structure, with an alternate disposition, of the hydrothecæ. It is a strong, rather rigid form, with the stem fascicled towards the base, but becoming monosiphonic distally, and attaining a height of between two and three inches.

The gonangia are compressed so as to present a lenticular form, more convex on one side than on the other, the more convex side being that which is turned towards the supporting pinna. They are entirely destitute of all trace of annulation and have their walls perfectly smooth. The male gonangium is smaller than the female, but otherwise differs but little from it in shape.

This highly interesting species was obtained along with *Synthecium campylocarpum*, from a depth of between 30 and 35 fathoms, off Port Jackson.

Thecocladium, Allman.

Thecocladium, Allman, Journ. Linn. Soc. Lond. (Zool.), vol. xix. p. 149, pl. xix. figs. 4, 5.

Generic Character. Trophosome.—Branching stems set with disjunct hydrothecæ and jointed at distant and uncertain intervals. Branches having their origin within the hydrothecæ.

Gonosome.—Gonangia ovate vesicles borne along the stems and branches and destitute of marsupium.

The genus *Thecocladium* agrees with *Thuiaria* in the absence of internodes of definite length. It differs from it, however, in the very remarkable origin of the branches, which invariably spring from within the hydrothecæ, passing out through the orifice, and then extending themselves externally.

The proximal end of the branch in *Thecocladium* can be traced through the axis of a hydrotheca whose cavity it completely fills, while its cœnosarc is continuous through the floor of the hydrotheca with the cœnosarc of the stem or branch from which it springs.

We are here reminded of the genus *Synthecium*, in which the gonangia have an origin exactly similar to that of the branches in *Thecocladium*, the peduncle of the gonangium occupying in *Synthecium* the cavity of the hydrotheca, at the orifice of which it becomes free in order to bear the gonangium on its summit.

Thecocladium flabellum, n. sp. (Pl. XXXVIII. figs. 1–4).

Trophosome.—Stems springing from one side of a rooted but otherwise free stolon-like tube, monosiphonic, much branched, branches alternate, all in one plane; stems and branches closely set with hydrothecæ. Hydrothecæ alternate, tubular, tumid below, adnate to the hydrocaulus for nearly their entire height; orifice circular and entire, with the margin continued for a short distance as a free, thin, membranous prolongation.

Gonosome.—Gonangia springing each from a point just below the base of a hydrotheca, oboviform, annulated, terminating distally in a sessile, even orifice, and with a longitudinal furrow running along the epicauline side.

Locality.—Simon's Bay, Cape of Good Hope; depth, 10 to 20 fathoms.

Thecocladium flabellum is the only representative as yet known of the remarkable genus to which it belongs. The stolon-like tube from which the stems arise sends off from distance to distance a cluster of root-fibres, but is free in the intervening spaces instead of being as in other Hydroids creeping and adherent throughout. It usually assumes an arched form, and from the convexity of the arch the stems arise at nearly equal intervals. The stolon is destitute of hydrothecæ, but the stems carry them along their entire length.

Soon after their origin the stems begin to give off pinnately disposed branches, which differ in no respect from the main stems except in being shorter. The branches as well as the stems all lie in the same plane, and this gives to the colony a somewhat flabelliform habit, which, however, is not strictly maintained in the older specimens. The branches are sometimes prolonged by tendril-like, coarsely annulated extensions of the axis, which, uniting with neighbouring branches, contribute still further to the flabelliform habit of the colony. These prolongations of the branches usually direct themselves towards the orifice of a hydrotheca, where they become attached, and are probably here in direct communication with the contents of the hydrotheca.

The hydrothecæ are very regularly alternate, and with their tumid bases give a slightly wavy outline to the stems and branches. Their distal ends are continued for a short distance by a delicate and easily torn membranous extension of their margin.

The disposition of the branches is alternate and pinnate in accordance with that of the hydrothecæ, out of whose orifices they extend themselves. They occur, however, at no regular distances, and there is nothing in the position or form of the hydrothecæ

from which they are emitted to give any indication that these are destined for branches and not for hydranths.

The gonangia are borne along the stems and branches. They spring each from a point just below a hydrotheca, and extend over a space corresponding in height to that of about three consecutive hydrothecæ. They are oboviform and strongly annulated, but are closely pressed to the hydrocaulus, and in consequence present at their epicauline side a deep, longitudinal furrow, whose sides overlap the hydrocaulus, and into which the annulation does not extend. Their summit carries the sessile, elliptical orifice.

The specimens have a height of between two and three inches, and were dredged in Simon's Bay, from a depth of 10 to 20 fathoms.

In a collection of Hydroids belonging to Miss H. Gatty is a small dry specimen of a Hydroid from an unknown locality, which, notwithstanding some slight differences, must be referred to the species here described.[1] It differs from the Challenger specimen in having the orifice of the hydrotheca surrounded by a slightly thickened rim. The hydrotheca was probably prolonged beyond this rim by a membranous extension of its margin, but in the dried specimen nothing but a faint indication of this could be detected.

Another feature, probably transitory, in Miss Gatty's specimen, consists in the presence of a delicate diaphragm, apparently chitinous, which intersects the hydrotheca obliquely, passing from a point near the middle of the apocauline wall downwards to a point on the epicauline wall a little above the base of the hydrotheca. No trace of these diaphragms was present in the specimens collected by the Challenger. The diaphragm is apparently complete and strongly recalls the so-called epiphragm excreted by certain snails as a defence against the injurious action of climate and other unfavourable surroundings.

I am not disposed to regard either of these differences as affording grounds for specific separation. It is by no means improbable that the diaphragm seen in the hydrotheca is a temporary structure excreted over the retracted hydranth for protection during a resting or inactive period of its existence; and the differences between the two forms ought probably to be regarded as pointing to different states of one and the same species.

No gonosome was present in the specimen contained in Miss Gatty's collection.

Family IDIIDÆ.

Character of the Family. Trophosome.—Hydrothecæ adnate to the hydrocaulus. Cœnosarc divided into segments which form two longitudinal series of intercommunicating chambers, each of which corresponds to a hydranth, with the gastral cavity of which it is continuous.

[1] See *Journ. Linn. Soc. Lond.* (Zool.), vol. ix., March 1885.

Gonosome.—Gonangia simple capsules destitute of marsupial chamber.

The character here assigned to the family of the Idiidæ includes certain points of structure which must be regarded as of high systematic value, rendering necessary the allocation of the family to a separate section or legion of the Calyptoblastea. To this section the name of Thalamophora may be assigned (see Introduction, Scheme of Hydroid Classification).

The facts which appear to justify this view will be obvious from the anatomical details given below under the description of the genus.

Idia, Lamouroux.

Idia, Lamouroux, Polyp. Coral. flex., p. 199.

Generic Character. Trophosome.—Hydrocaulus consisting of a main stem with pinnately disposed ramuli which support numerous alternate hydrothecæ adnate to one another along the mesial line of the ramulus.

Gonosome.—Gonangia (in the only known species) urn-shaped capsules springing from the main stem.

The characters given above are all that are needed for the generic diagnosis of *Idia*, and will prevent its being confounded with any other genus hitherto described. From *Desmoscyphus*, whose hydrothecæ are, as in *Idia*, connate to one another along the mesial line of the ramulus, it may at first sight appear not easily distinguishable. But we must bear in mind that while in *Desmoscyphus* the hydrothecæ are opposite, they are in *Idia* strictly alternate, though notwithstanding this alternate disposition, the close approximation in a longitudinal line of the hydrothecæ composing each linear series allows of the two series laterally coalescing with one another in the median line of the pinna.

It is, however, when we come to examine its anatomical structure that we meet with features in *Idia* so peculiar and so distinct from those of any other known Hydroid, that we are compelled to regard this remarkable form as the representative of an entirely new family.

The specimens of *Idia pristis* obtained by the Challenger have the soft parts of the trophosome fairly well preserved, and though the oral extremities of the hydranths with the tentacles have entirely disappeared, the cœnosarc is sufficiently perfect to allow of a satisfactory determination of some of its more important features.

Perisarc.—The skeleton or chitinous perisarc of *Idia pristis* is very remarkable. In every ramulus or pinna we must distinguish two aspects:—A front aspect along which the hydrothecæ are adnate to one another by their opposed sides, and a posterior aspect on which they do not show themselves.

On the anterior side (Pl. XXXIX. fig. 2) the union of the adnate hydrotheca-walls may

be seen to form on the surface of the ramulus a continuous zigzag line lying in the general direction of its axis. The posterior side, on the contrary, is destitute of markings of any kind, but when focused at a little distance below the surface (fig. 3) there will be brought into view two longitudinal series of irregularly polygonal areolæ, those of each series alternating with those of the other, and being throughout in close contact with them. They are bounded by chitinous laminæ which pass off from the anterior walls of the common perisarcal tube, and penetrating into the interior of this, give rise to two longitudinal series of chambers which are lined by the cœnosarc in the way about to be seen.

Between the posterior walls of the ramulus and this double series of chambers is a space occupying the entire width of the ramulus, and forming a posterior longitudinal chamber which extends continuously through the entire ramulus (fig. 5 ; fig. 8, *c*).

The hydrothecæ terminate each in a very oblique orifice, which is directed posteriorly and is provided with a delicate membranous valve (figs. 3, 4, 9).

Cœnosarc.—All the areolæ or anterior chambers just mentioned are lined by the cœnosarc, which instead of forming as in other Hydroids a continuous uninterrupted tube, is broken up into two longitudinal series of segments (figs. 4, 5 ; fig. 8, *b*). There can be little doubt that the segments of one and the same series freely communicate with one another through the chitinous walls of the chambers.

The cœnosarc by which these segmental chambers are lined consists of a thick endodermal layer overlaid by a thin ectoderm, and enclosing that portion of the common somatic cavity which lies in each segment. With each of these segments a hydranth is directly continuous (fig. 5), and every hydranth thus corresponds to one of the transverse segments into which the common cœnosarc of the ramulus is divided, and has its gastral cavity opening directly into the cavity of the segment.

The great longitudinal posterior chamber (fig. 5 ; fig. 8, *c*) is also lined by a layer of cœnosarc. This, however, is thinner than that of the anterior transverse chambers, and was but imperfectly preserved in the specimen.

The pinnately disposed ramuli of *Idia pristis* thus present a structure which, so far as is known, does not occur elsewhere among the Hydroida. The division of the common chitinous perisarcal tube into distinct chambers, and the consequent division and segmentation of the cœnosarc, constitute a combination of characters which, however far we may be from assigning to it its true significance, is of sufficient systematic value to necessitate the relegation of *Idia* to a separate section among the Calyptoblastic Hydroids.

While the structure of the pinnæ is thus so very exceptional, that of the common stem (fig. 6) differs but little from the usual condition of this part in the Sertularian Hydroids. The hydrothecæ are as in the pinnæ alternate, but those of opposite sides show no tendency to coalesce, being on the contrary separated from one another by a

wide interval of the stem, into the cavity of which that of the hydrotheca opens through the medium of a short tubular continuation of its proximal end.

The perisarcal tube of the stem is simply continuous and monothalamic, and its contained cœnosarc is consequently quite destitute of the peculiar segmentation which is so striking in the pinnæ. The cœnosarc of the stem lines the perisarc with a rather thin layer, whose endoderm is thrown into an irregular network of tubular ridges, a condition which prevails also in *Antennularia*, and is elsewhere not without its parallel among the Hydroida.

Idia pristis, Lamouroux (Pl. XXXIX. figs. 1–10).

Idia pristis, Lamouroux, Polyp. Coral. flex., p. 200, pl. v. fig. 5.

Trophosome.—Stem monosiphonic, simple,[1] springing from a plexus of tubular filaments, and sending off along nearly its entire length moderately long, rather close-set, alternate pinnæ, which are for the most part intersected by transverse joints at distant and variable intervals. Hydrothecæ of pinnæ alternate, with their opposed sides adnate to one another, and with the free distal end diverging at a wide angle from the hydrocaulus, tapering to a point and opening by a very oblique orifice which is directed backwards, and closed by a membranous valve; hydrothecæ of stem not adnate by their opposed sides.

Gonosome.—Gonangia borne exclusively by the main stem, each springing from a point just below the base of a hydrotheca, urniform, longitudinally fluted, attached to the stem by a short but definite peduncle; summit abruptly narrowed into a conical roof, which bears on its apex the wide, circular orifice.[2]

Locality.—Station 203, off Panay, Philippine Islands; lat. 11° 61′ N., long. 123° 9′ E.; depth, 20 fathoms.

Off Bahia; depth, probably 10 to 20 fathoms.

Idia pristis is the only known representative of the genus; and the only description of it hitherto published consists in the short and inadequate diagnosis given by Lamouroux.

It occurs in the form of groups of undivided stems which send off along nearly their

[1] The apparently branched condition of the main stem is due to a cause different from that of a true ramification. See below, p. 86.

[2] Lamouroux, to whom we owe the original definition of the genus *Idia*, knew nothing of the gonosome, and, except in a short notice by Mr. Hincks (*Journ. Linn. Soc. Lond.* (Zool.), vol. xxi., 1887), this important part of the colony has hitherto remained undescribed. Mr. Busk, however, had many years ago examined it in specimens from the Persian Gulf, and I am indebted to him for an opportunity of inspecting the excellent figures which he then made of the gonangia. He has also placed his specimens in my hands, and I have thus been enabled to compare these with the examples brought home by the Challenger. One of the examples of *Idia pristis*, dredged by the Challenger off Bahia, is furnished with gonangia. No gonosome is present in any of the other specimens.

entire course short pinnæ which differ but little in length. The wide angle at which the distal ends of the hydrothecæ diverge from the pinnæ, and the narrow point in which they terminate, give to the pinnæ with its two rows of hydrothecæ a not very distant resemblance to the saw of a sawfish,—a resemblance which suggested to Lamouroux the specific name of *pristis*.

The pinnæ spring by a narrow base, each from a short cladophore. Some of them present one or two well-marked constrictions, which are not situated at any regular distance from one another, and by which the pinna becomes divided into two or more internodes of variable length. Some of the pinnæ, however, show no constriction in any part of their course, and no trace of division into distinct internodes.

The distal extremities of the hydrothecæ in both pinnæ and main stem, after diverging at a wide angle end in a point which forms the apocauline boundary of a wide orifice. The plane of this orifice in the pinnæ is directed backwards, while in the stem it looks more towards the distal end of the colony. In both the orifice is completely covered by a thin membrane, the distal half of which is free and capable of being raised from the orifice in the form of a valve-like lid.

The structure of the stem differs widely from that of the pinnæ, and in most respects resembles the usual structure of this part in the Sertularian Hydroids. It is divided by well-marked joints into a series of equal internodes, each of which sends off a pinna from alternate sides near its proximal end. The hydrothecæ, which are deep and nearly cylindrical, are alternately disposed and are confined to one aspect of the stem, which thus presents as in the pinnæ an anterior and a posterior aspect, but the hydrothecæ of the stem show no tendency as in the pinnæ to coalesce with one another along the mesial line.

The hydrothecæ of the stem do not open directly into the common tube, but each communicates with it through the medium of a small chamber, which forms an appendage to the base of the hydrothecæ and opens by a well-defined circular orifice into the cavity of the stem. These little chambers are probably the representatives of the much larger adnate chambers into which the hydrothecæ open in the pinnæ.

The gonangia arise each from a point close to the base of a hydrotheca, and care must be taken not to mistake the optical expression of the orifice of the accessory chambers just mentioned for the spot from which a gonangium had become detached. The short neck, which carries on its summit the orifice of the gonangium, is encircled by a wreath of minute puncta, which recalls a very similar condition in the limbus of the hydrophore of *Halecium*.

A very interesting feature in the economy of *Idia pristis* consists in the apparent ramification of the stem. In all the specimens which I have examined, whether those brought home by the Challenger or those in the possession of Mr. Busk, the main stems, besides sending off the pinnæ, have the appearance of dividing into a greater or smaller

number of branches, which repeat in all respects the primary stems with their pinnæ. In a magnificent specimen belonging to Mr. Busk, which was obtained in the Persian Gulf and attains a height of nearly a foot, the trophosome consists of numerous stems which spring in a close cluster from a plexus of tubular fibres. Soon after their origin almost all these stems appear to give off a great number of branches, and the specimen, instead of consisting essentially of a cluster of undivided stems with pinnately disposed ramuli, appears to form a profusely branched colony. The apparent branches, however, are in reality so many separate colonies which had attached themselves to the primary stems, which they grasp by their hydrorhizal tubules (Pl. XXXIX. fig. 10).

An entirely similar condition occurs in the Challenger specimens, both in those from the Philippine Islands and in those dredged off Bahia, none of which, however, possess a height of more than five inches, and in which the associated stems are but few. Among the Hydroids collected by the "Rattlesnake" is also a specimen of *Idia pristis* from the Australian Seas. Like the Challenger specimens it is of small size, and the separate colonies associated with it in the form of branches are but few.

Mr. Hincks lately sent me a specimen of *Idia pristis* which he had identified in a collection of Hydroids brought home from the Mergui Archipelago. The specimen, which is abundantly supplied with gonangia, presents a pseudo-ramification similar in all respects to that of the other examples here noticed.

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PLATE I.

PLATE I.

Figs. 1–1*a*.—*Eudendrium vestitum* (p. 3).

Fig. 1.—A colony of the natural size, attached to an echinus spine.

Fig. 1*a*.—A portion of a colony; magnified about 25 diameters.

Figs. 2, 2*a*.—*Stylactis vermicola* (p. 2).

Fig. 2.—Part of a specimen of *Lætmonice producta*, seen from the dorsal side after the removal of one of the series of dorsal plates in order to expose the colony of *Stylactis vermicola* which had attached itself to the back of the Annelid; natural size.

Fig. 2*a*.—A portion of a colony, with hydranths and gonophores; magnified 20 diameters.

Hollick lith.

West, Newman & C°imp.

1. 1ª EUDENDRIUM VESTITUM. 2. 2ª STYLACTIS VERMICOLA.

PLATE II.

PLATE II.

Figs. 1, 2.—*Eudendrium rameum* (p. 4).

Fig. 1.—An entire colony; natural size.

Fig. 2.—A portion of a colony; magnified about 15 diameters.

A.T.Hollick lith.

West, Newman & Co° imp.

EUDENDRIUM RAMEUM.

PLATE III.

PLATE III.

Figs. 1–7.—*Monocaulus imperator* (p. 5).

Fig. 1.—The hydranth and gonophores, with the distal portion of the stem; natural size.

Fig. 2.—The proximal end of the stem; natural size.

Fig. 3.—One of the branching peduncles of the gonosome with its clusters of gonophores; magnified about 15 diameters.

Fig. 4.—A portion of a transverse section of the wall of the stem; magnified about 12 diameters, and slightly diagrammatic.

a. Ectoderm.
b. Elastic tissue of the stem.
c. Endoderm.
d. Longitudinal canals of the endoderm.

Fig. 5.—Portion of stem seen from the outer surface after maceration; magnified 50 diameters.

a. Elastic tissue partly denuded of the ectoderm.
b. Some of the ectoderm cells still adhering to the outer surface of the elastic tissue.

Fig. 6.—Some of the fibres of the elastic coat breaking up into finer fibrillæ; magnified 100 diameters.

Fig. 7.—Outline of a transverse section of the stem, showing the manner in which the walls are thrown into folds by the action of the elastic coat; slightly enlarged.

A. T. Hollick lith.

West, Newman & Co. imp.

MONOCAULUS IMPERATOR.

PLATE IV.

PLATE IV.

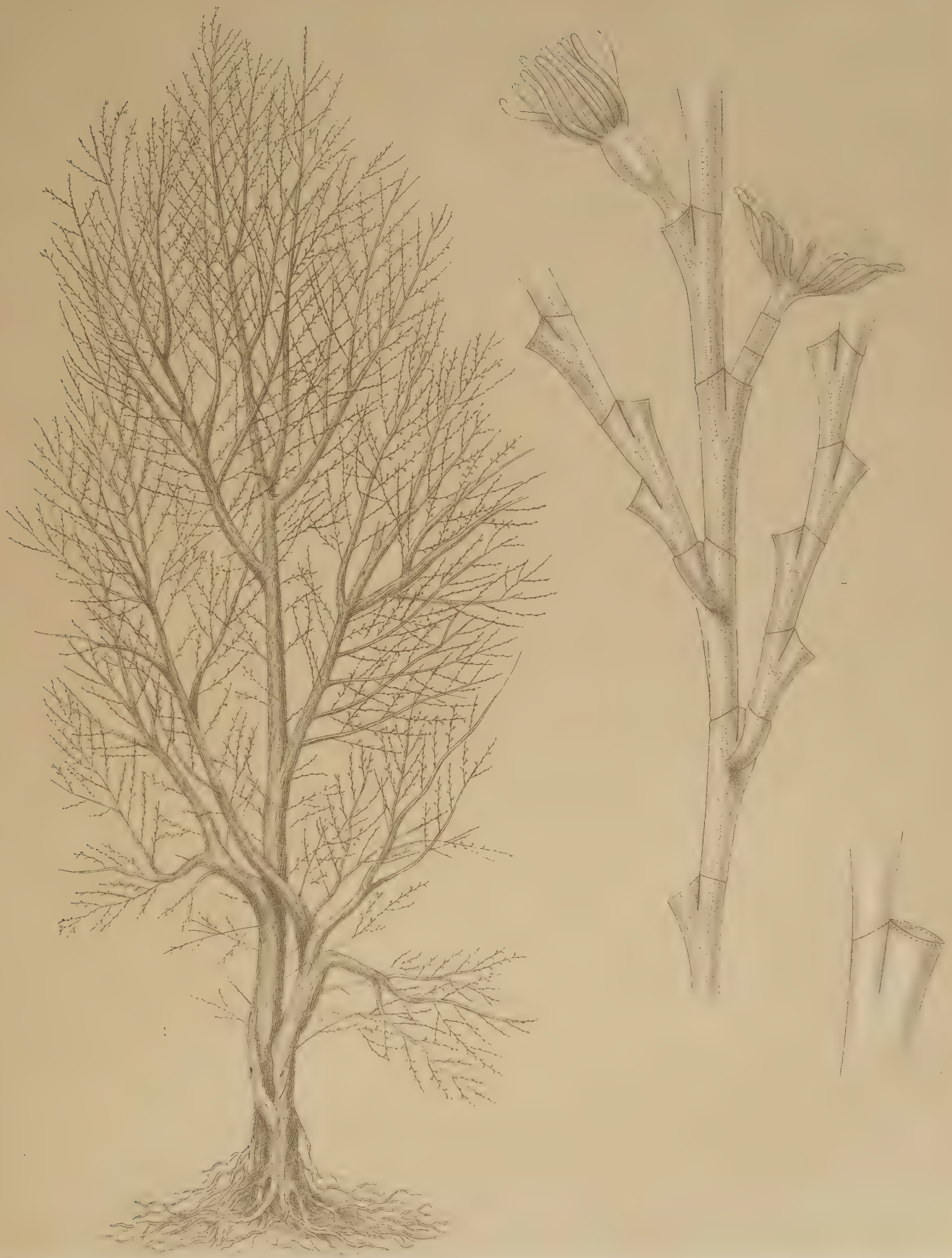
Figs. 1–3.—*Halecium arboreum* [*robustum*][1] (p. 10).

Fig. 1.—An entire colony; natural size.

Fig. 2.—Portion of a colony; magnified 15 diameters.

Fig. 3.—A hydrophore, showing its basal segment adnate by its epicauline side to the supporting internode, and its very narrow limbus; magnified 20 diameters.

[1] It has been found necessary to change the name since the plate was printed off.



A. T. Hollick lith.

West, Newman & C°imp

HALECIUM ROBUSTUM.

PLATE V.

PLATE V.

Figs. 1, 1*a*.—*Halecium telescopicum* (p. 10).

Fig. 1.—Portion of a colony ; natural size.

Fig. 1*a*.—Portion of the same colony ; magnified 15 diameters.

Figs. 2, 2*a*.—*Halecium flexile* (p. 11).

Fig. 2.—An entire colony ; natural size.

Fig. 2*a*.—A portion ; magnified 15 diameters.

A. T. Hollick lith.

West, Newman & Co. imp.

1, 1ª HALECIUM TELESCOPICUM. 2, 2ª HALECIUM FLEXILE.

PLATE VI.

PLATE VI.

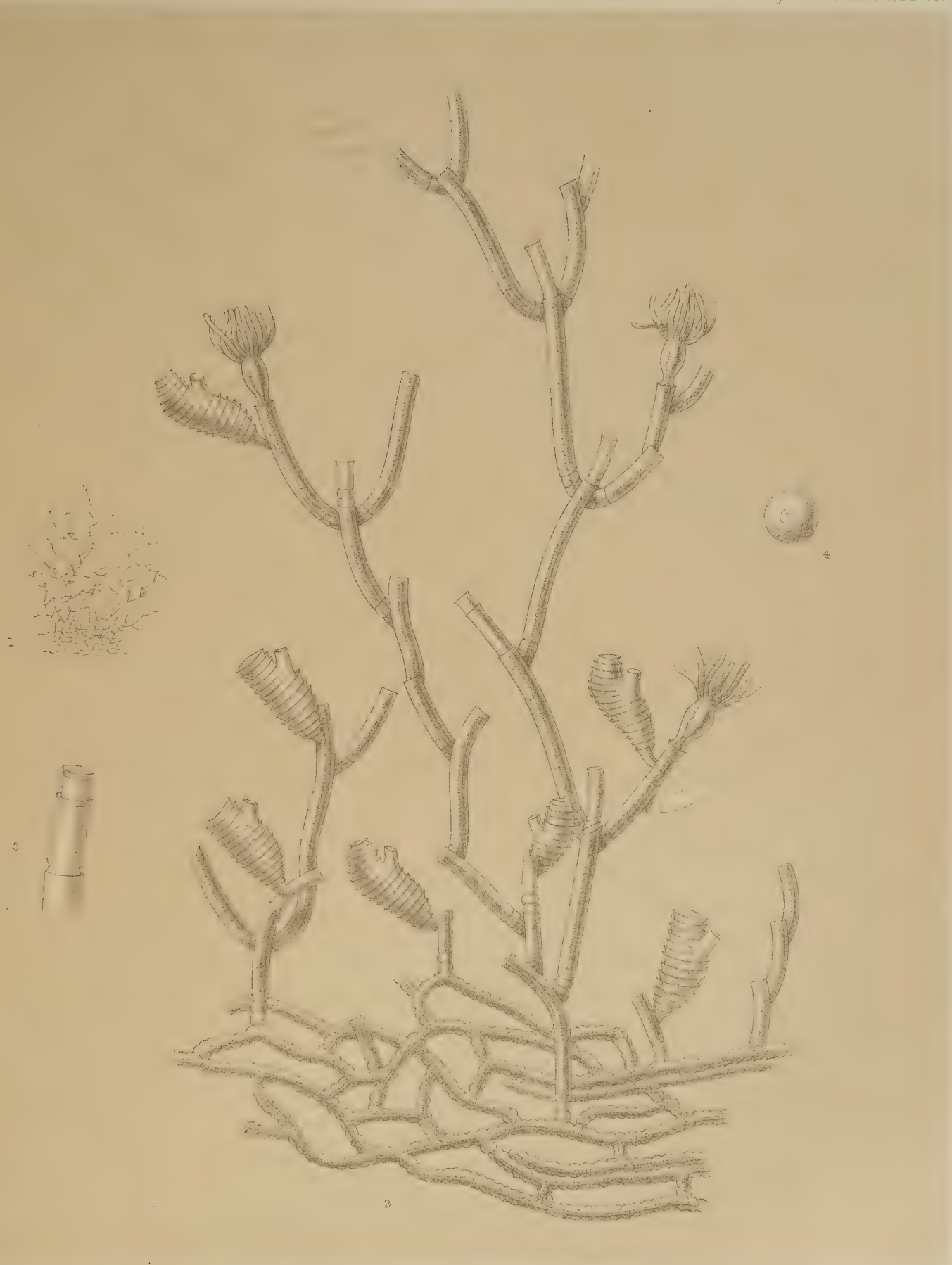
Figs. 1–4. *Halecium dichotomum* (p. 13).

Fig. 1.—A colony; natural size.

Fig. 2.—A portion of a colony; magnified 15 diameters.

Fig. 3.—Two consecutive hydrophores; magnified about 20 diameters.

Fig. 4.—Ovum with germinal vesicle and spot; magnified 30 diameters.



A.T. Hollick lith.

West, Newman & Co.ª imp.

HALECIUM DICHOTOMUM.

PLATE VII.

PLATE VII.

Figs. 1–5.—*Halecium cymiforme* (p. 15).

Fig. 1.—A colony growing over the stems and branches of some other dendritic Hydroid; natural size.

Fig. 2.—Portion of a colony; magnified 20 diameters.

Fig. 3.—Outline of portion of a colony near its base, showing the fascicled basal tubes and the origin of the free portion of the colony; magnified about 15 diameters.

Fig. 4.—Young gonangium (male?) with its contents; magnified about 60 diameters.

a. Blastostyle.
b. Sporosac.
c. Ectodermal investment of the sporosac, sent off from the walls of the blastostyle.
d. Inner layer of the cap-like covering of the sporosac.
e. Outer layer of same.

Fig. 5.—More mature gonangium (male?) with its contents; magnified about 40 diameters.

a. Blastostyle.
b. Sporosac.
c. Ectodermal investment of the sporosac, sent off from the walls of the blastostyle. The structures forming the cap of the sporosac have here disappeared.

HALECIUM CYMIFORME.

PLATE VIII.

PLATE VIII.

Figs. 1–3.—*Diplocyathus dichotomus* (p. 17).

Fig. 1.—A colony; natural size.

Fig. 2.—Portion of a colony; magnified 20 diameters.

Fig. 3.—A hydrophore with hydranth and sarcotheca. The sarcostyle is seen to be partly protruded from the sarcotheca; magnified 25 diameters.

A.T.Hollick lith

West, Newman & Co. imp.

DIPLOCYATHUS DICHOTOMUS.

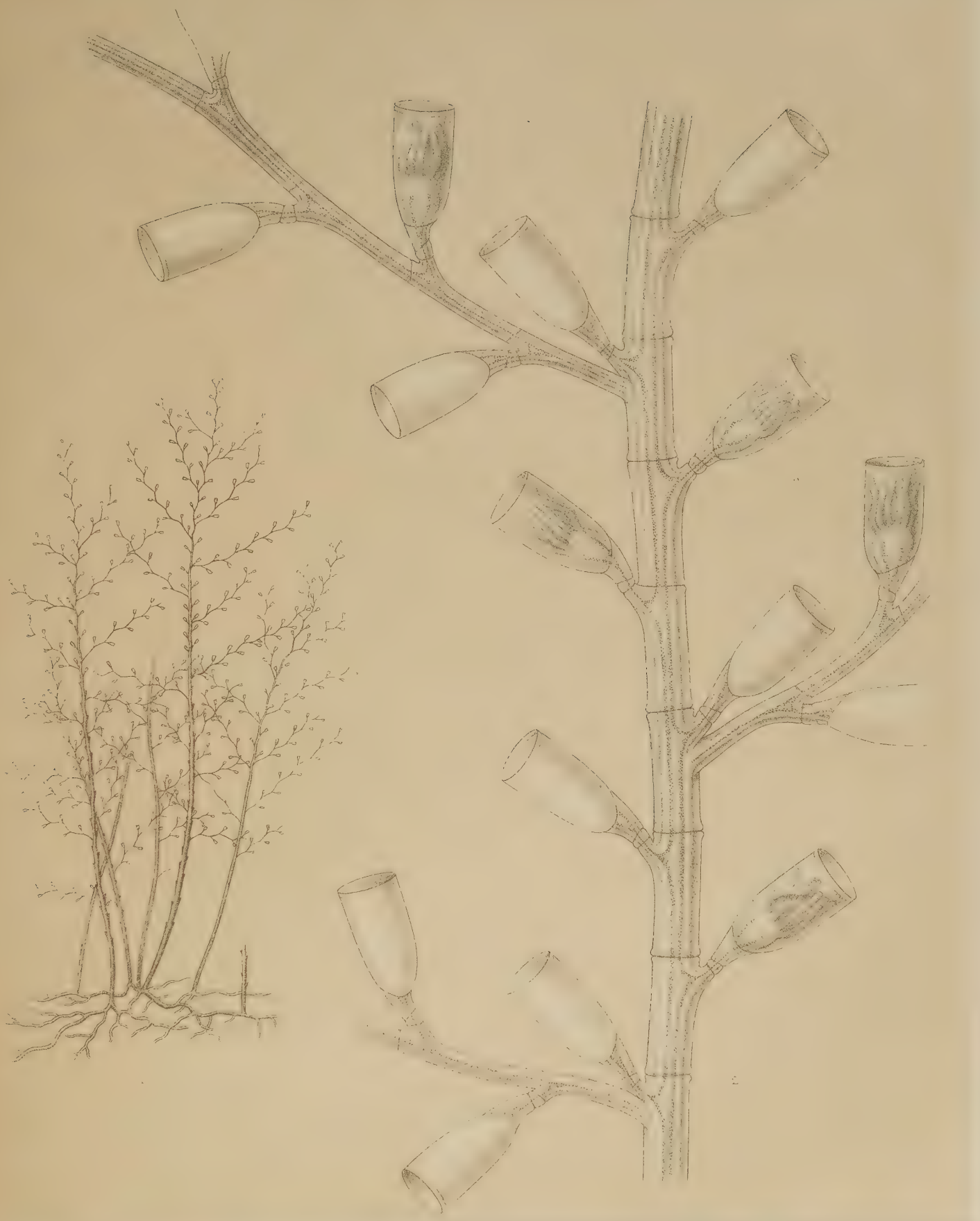
PLATE IX.

PLATE IX.

Figs. 1, 2.—*Campanularia insignis* (p. 19).

Fig. 1.—A colony; natural size.

Fig. 2.—Portion of a colony; magnified about 10 diameters.



A. Hodgetts lith

West, Newman & Co. imp

CAMPANULARIA INSIGNIS.

PLATE X.

PLATE X.

Figs. 1, 1*a*, 1*b*.—*Campanularia tulipifera* (p. 20).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—The same; magnified 5 diameters.

Fig. 1*b*.—A hydrotheca, still further magnified.

Figs. 2, 2*a*.—*Campanularia ptychocyathus* (p. 20).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 10 diameters.

Figs. 3, 3*a*.—*Calamphora parvula* (p. 29).

Fig. 3.—A colony; natural size.

Fig. 3*a*.—Portion of a colony; magnified 25 diameters. The large gonangium is seen springing from the creeping stolon close to the base of a hydrotheca.

T. Hollick lith.

West, Newman & Co imp.

1, 1a 1b CAMPANULARIA TULIPIFERA. 2, 2a CAMPANULARIA PTYCHOCYATHUS.
3, 3a CALAMPHORA PARVULA.

PLATE XI.

PLATE XI.

Figs. 1, 1*a*.—*Campanularia retroflexa* (p. 21).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Portion of a colony; magnified 15 diameters.

Figs. 2, 2*a*.—*Campanularia cheloniæ* (p. 22).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 25 diameters.

Figs. 3, 3*a*.—*Lictorella cyathifera* (p. 36).

Fig. 3.—A colony; natural size.

Fig. 3*a*.—Portion of a colony; magnified 15 diameters.

A.T.Hollick lith

West, Newman & C° imp

1, 1ª CAMPANULARIA RETROFLEXA. 2, 2ª CAMPANULARIA CHELONIÆ.
3, 3ª LICTORELLA CYATHIFERA.

PLATE XII.

PLATE XII.

Figs. 1, 1*a*.—*Obelia geniculata* (p. 23).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Portion of a colony; magnified 15 diameters.

Figs. 2, 2*a*.—*Thyroscyphus ramosus* (p. 24).

Fig. 2.—Portion of colony; natural size.

Fig. 2*a*.—Portion of the same; magnified 15 diameters.

Figs. 3, 3*a*.—*Halecium beanii* (p. 12).

Fig. 3.—A colony; natural size.

Fig. 3*a*.—Portion of a colony with female gonangia; magnified 15 diameters.

A. T. Hollick lith.

West, Newman & Cº imp.

1, 1ª OBELIA GENICULATA. 2, 2ª THYROSCYPHUS RAMOSUS.
3, 3ª HALECIUM BEANII.

PLATE XIII.

PLATE XIII.

Figs. 1, 2.—*Thyroscyphus simplex* (p. 25).

Fig. 1.—A colony; natural size.

Fig. 2.—Portion of a colony; magnified 15 diameters.

A. T. Holbek lith.

West, Newman & C° imp.

THYROSCYPHUS SIMPLEX.

PLATE XIV.

PLATE XIV.

Figs. 1, 1*a*.—*Hypanthea aggregata* (p. 26).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Portion of a colony; magnified 15 diameters.

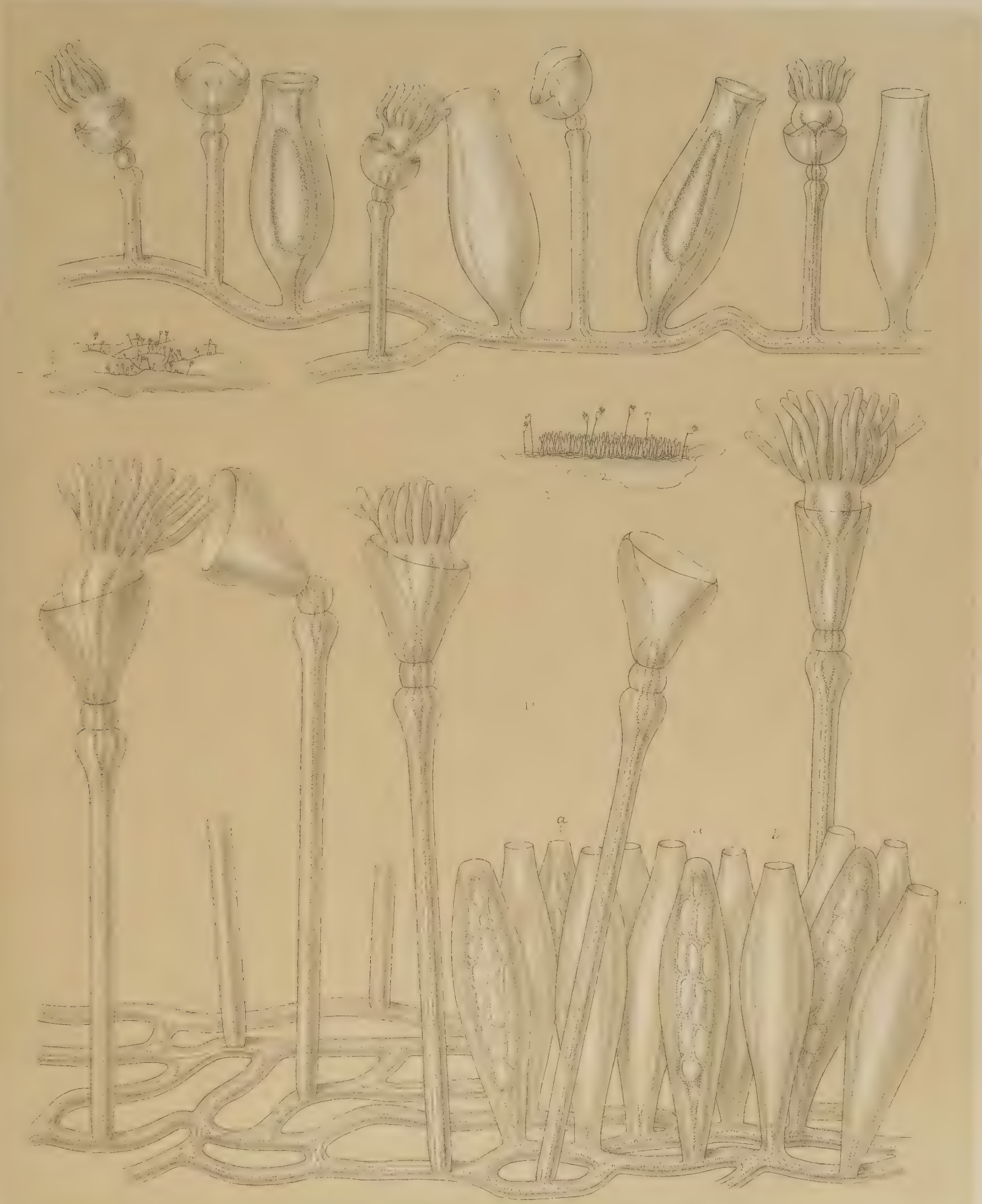
a. Gonangia occupied by the solitary sporosac surrounded by a network of tubes into which the blastostyle has become broken up.

b. Empty gonangia.

Figs. 2, 2*a*.—*Hypanthea hemispherica* (p. 27).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 15 diameters.



A.T.Hollick lith

West, Newman & Co.° imp

1. 1ª HYPANTHEA AGGREGATA. 2. 2ª HYPANTHEA HEMISPHERICA.

PLATE XV.

PLATE XV.

Figs. 1, 1*a*.—*Lafoëa dumosa* (p. 34).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Portion of a colony; magnified 15 diameters.

Figs. 2, 2*a*.—*Halecium fastigiatum* (p. 13).

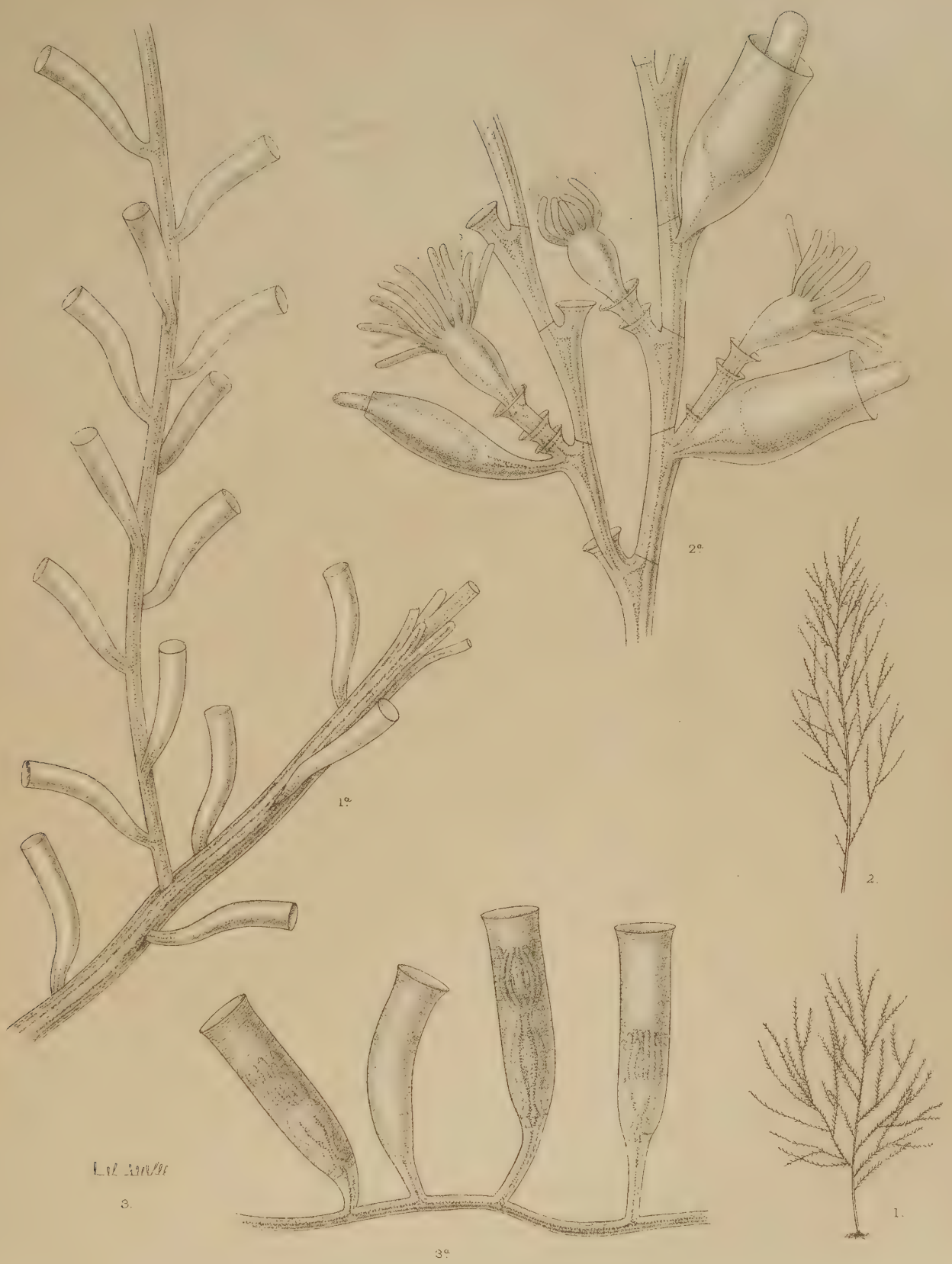
Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 15 diameters.

Figs. 3, 3*a*.—*Hebella striata* (p. 30).

Fig. 3.—Portion of a colony; natural size.

Fig. 3*a*.—Portion of same; magnified 25 diameters.



A T Hollick lith

West, Newman & Co. imp.

1, 1a LAFOËA DUMOSA. 2, 2a HALECIUM FASTIGIATUM.
3, 3a HEBELLA STRIATA.

PLATE XVI.

PLATE XVI.

Figs. 1, 1*a*.—*Halisiphonia megalotheca* (p. 31).

Fig. 1.—Portion of a colony growing on the stem of another Hydroid.

Fig. 1*a*.—Portion of the same; magnified 10 diameters.

Figs. 2, 2*a*.—*Lafoëa fruticosa* (p. 34).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 15 diameters.

A T Hollick lith

West Newman & Co imp

1. 1A HALISIPHONIA MEGALOTHECA. 2. 2A LAFOËA FRUTICOSA.

PLATE XVII.

PLATE XVII.

Figs. 1, 2.—*Lictorella halecioides* (p. 35).

Fig. 1.—A colony; natural size.

Fig. 2.—Portion of a colony; magnified 15 diameters. The lower end shows the axial tube exposed by the removal of the peripheral tubes.

A.T. Hollick lith.

West, Newman & Co imp.

LICTORELLA HALECIOIDES.

PLATE XVIII.

PLATE XVIII.

Figs. 1, 1*a*, 1*b*.—*Cryptolaria humilis* (p. 39).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Portion of a colony; magnified 8 diameters.

Fig. 1*b*.—The same, after maceration in caustic potash; the axial tube with its hydrothecæ is seen in its entire extent, freed from the close investment of the peripheral tubes; magnified 10 diameters.

Figs. 2, 2*a*.—*Cryptolaria abyssicola* (p. 40).

Fig. 2.—Portion of a colony; natural size.

Fig. 2*a*.—Portion of same; magnified 10 diameters. Two gonangia are here seen.

A T Hollick lith

1, 1ᴬ 1ᴮ CRYPTOLARIA HUMILIS. 2, 2ᴬ CRYPTOLARIA ABYSSICOLA.

PLATE XIX.

PLATE XIX.

Figs. 1, 1*a*.—*Cryptolaria flabellum* (p. 40).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Portion of a colony; magnified 10 diameters.

Figs. 2, 2*a*.—*Cryptolaria pulchella* (p. 40).

Fig. 2.—Portion of a colony; natural size.

Fig. 2*a*.—Portion of same; magnified 10 diameters.

Figs. 3, 3*a*.—*Cryptolaria crassicaulis* (p. 41).

Fig. 3.—A colony; natural size.

Fig. 3*a*.—Portion of a colony; magnified 10 diameters.

A.T.Holmes lith. West, Newman & Co. imp.

1, 1ª CRYPTOLARIA FLABELLUM. 2, 2ª CRYPTOLARIA PULCHELLA.
3, 3ª CRYPTOLARIA CRASSICAULIS.

PLATE XX.

PLATE XX.

Figs. 1, 1*a*, 1*b*.—*Cryptolaria geniculata* (p. 41).

Fig. 1.—Portion of a colony; natural size.

Fig. 1*a*.—Portion of same, with two gonangia; magnified 10 diameters.

Fig. 1*b*.—Same after maceration in caustic potash. The axial and peripheral tubes separated from one another; magnified 10 diameters.

Figs. 2, 2*a*.—*Cryptolaria gracilis* (p. 42).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 10 diameters.

1. 1a 1b CRYPTOLARIA GENICULATA. 2. 2a CRYPTOLARIA GRACILIS.

PLATE XXI.

PLATE XXI.

Figs. 1, 1*a*.—*Cryptolaria diffusa* (p. 42).

Fig. 1.—Portion of a colony; natural size.

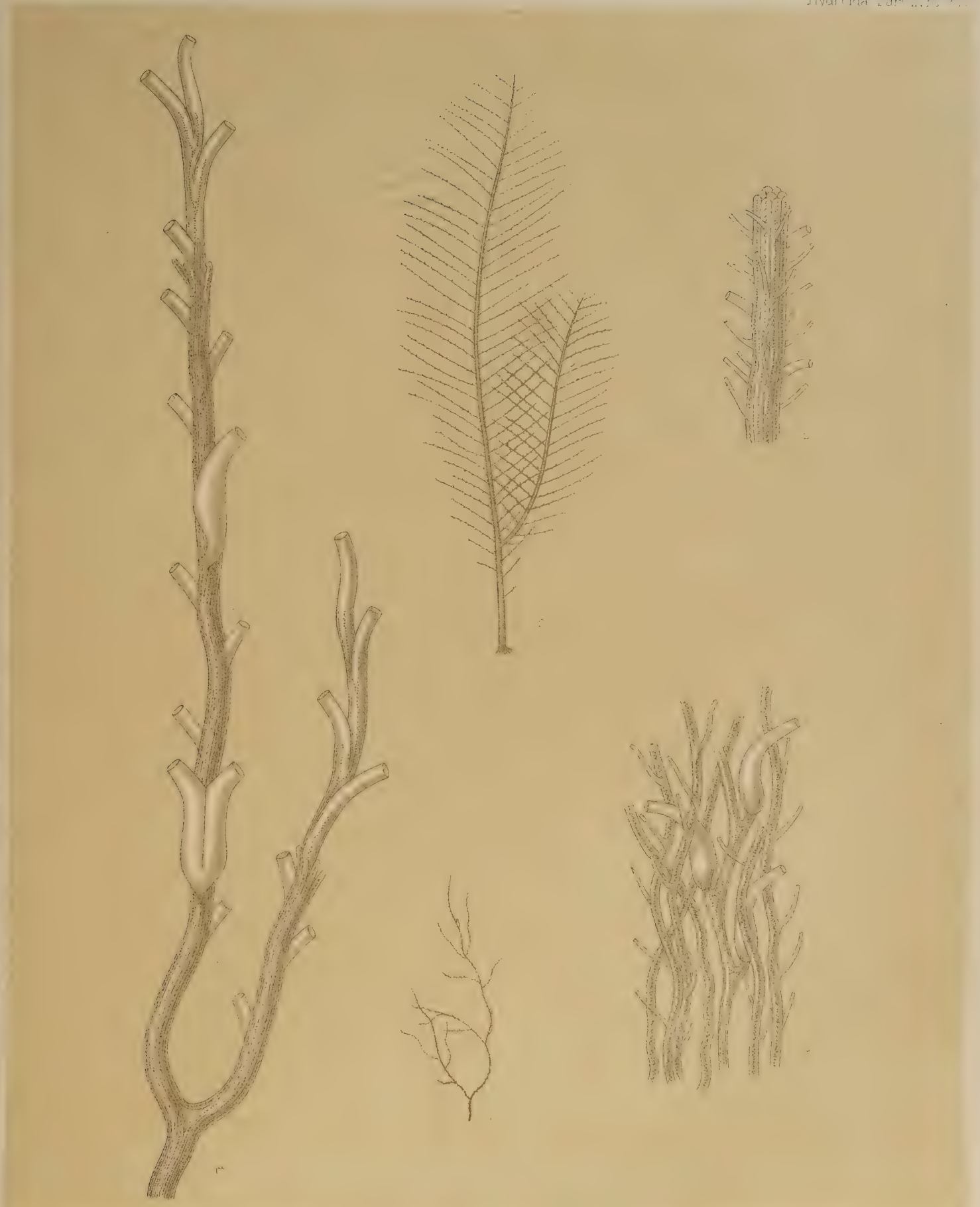
Fig. 1*a*.—Portion of same, with gonangia; magnified 10 diameters.

Figs. 2, 2*a*, 2*b*.—*Perisiphonia pectinata* (p. 45).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Distal end of a pinna, showing the extremities of the hydrothecæ projecting from between the peripheral tubes which carry the sarcothecæ; magnified 25 diameters.

Fig. 2*b*.—Portion of a pinna after maceration in caustic potash; the peripheral tubes detached from the axial tubes and carrying sarcothecæ; magnified 25 diameters.



A T Hollick lith

1. 1ª CRYPTOLARIA DIFFUSA. 2. 2ª 2ᴮ PERISIPHONIA PECTINATA

PLATE XXII.

PLATE XXII.

Figs. 1–4.—*Perisiphonia filicula* (p. 44).

Fig. 1.—A colony; natural size.

Fig. 2.—Distal end of a pinna; magnified 25 diameters. The axial and peripheral tubes are partly separated from one another after maceration in caustic potash. Where the peripheral tubes still remain in their natural position, the distal extremities of the hydrothecæ are seen projecting from between them. Sarcothecæ are seen to be carried by the outer peripheral tubes.

Fig. 3.—Portion of the stem after maceration in caustic potash; magnified 25 diameters. The axial tube has been nearly freed from the surrounding peripheral tubes. The origins of the pinnæ from the main stem are seen.

Fig. 4.—Outline of hydrotheca, showing a sarcotheca springing from its peduncle.

A.T. Hollick lith.

PERISIPHONIA FILICULA

PLATE XXIII.

PLATE XXIII.

Figs. 1, 1*a*.—*Grammaria stentor* (p. 48).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Part of a colony; magnified 10 diameters.

Figs. 2, 2*a*, 2*b*.—*Grammaria magellanica* (p. 48).

Fig. 2.—Part of a colony; natural size.

Fig. 2*a*.—Part of the same; magnified 10 diameters.

Fig. 2*b*.—Transverse section of a branch; magnified about 20 diameters.

a. Three hydrothecæ belonging to the same plane seen in section.
b. Distal extremities of three hydrothecæ belonging to a plane immediately below that of *a*.
c. Sections of three hydrothecæ which lie in a plane immediately above that of *a*, and which, as the section passes through them nearer to their origin, are still filled with the proximal part of the hydranth.
d. Section of the axial tube.
e. Peripheral tubes seen in section.

Figs. 3, 3*a*, 3*b*.—*Grammaria insignis* (p. 49).

Fig. 3.—Part of a colony; natural size.

Fig. 3*a*.—Part of the same; magnified 10 diameters.

Fig. 3*b*.—Transverse section of a branch; magnified about 20 diameters.

a. Two opposite hydrothecæ, seen in section.
b. Distal ends of two hydrothecæ which alternate with *a*, and lie in a plane immediately below that of *a*.
c. Sections of two hydrothecæ which lie in a plane immediately above that of *a*. As the section passes through them near their origin, the proximal part of the hydranth is still contained in them.
d. Section of the axial tube.
e. Peripheral tubes seen in section.

A.T.H. del. et lith.

West, Newman & Co. imp.

1, 1ᴬ GRAMMARIA STENTOR. 2, 2ᴬ, 2ᴮ GRAMMARIA MAGELLANICA.
3, 3ᴬ, 3ᴮ GRAMMARIA INSIGNIS.

PLATE XXIV.

PLATE XXIV.

Figs. 1, 1*a*.—*Sertularia filiformis* [*gracilis*][1] (p. 51).

Fig. 1.—A colony; natural size.

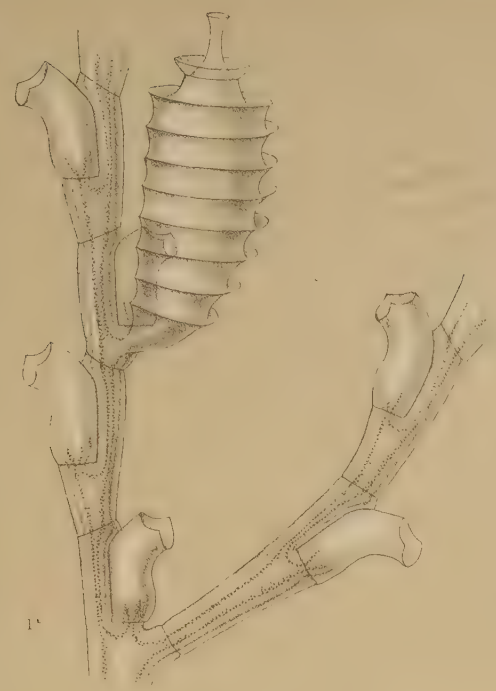
Fig. 1*a*.—Portion of a colony; magnified 15 diameters.

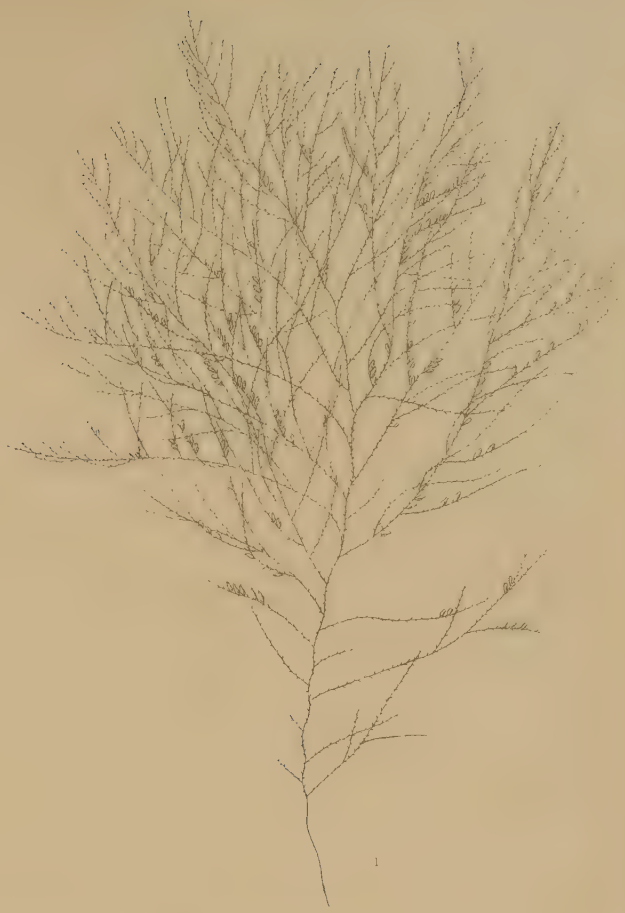
Figs. 2, 2*a*.—*Sertularia annulata* (p. 52).

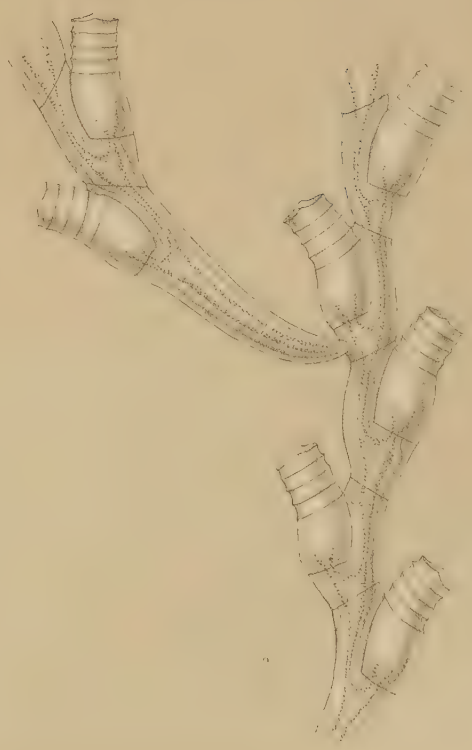
Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 15 diameters.

[1] It has been found necessary to change the name since the plate was printed off.







1. 1A SERTULARIA GRACILIS. 2. 2A SERTULARIA ANNULATA.

PLATE XXV.

PLATE XXV.

Figs. 1, 1*a*.—*Sertularia leiocarpa* (p. 52).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Portion of a colony; magnified 15 diameters. In the retracted hydranth (α) near the distal end of the figure the gastral cavity is seen to be doubled on itself. In the gonangium the peripheral points of attachment of the transverse ectodermal bands which extend from the central structures to the gonangium walls, are seen in the form of stellate cells adherent to the inner surface of the walls.

Figs. 2, 2*a*, 2*b*.—*Sertularia secunda*[1] [*unilateralis*] (p. 53).

Fig. 2.—A colony, front view; natural size.

Fig. 2*a*.—The same, dorsal view.

Fig. 2*b*.—Portion of a colony; magnified 15 diameters.

Figs. 3, 3*a*.—*Sertularia clausa* (p. 54).

Fig. 3.—A colony; natural size.

Fig. 3*a*.—Portion of a colony; magnified 15 diameters.

[1] It has been found necessary to change the name since the Plate was printed off.

A.T. Hollick lith

West, Newman & Co. imp

1, 1ᴬ SERTULARIA LEIOCARPA. 2. 2ᴬ 2ᴮ SERTULARIA UNILATERALIS.
3, 3ᴬ SERTULARIA CLAUSA.

PLATE XXVI.

PLATE XXVI.

Figs. 1, 1*a*.—*Sertularia implexa* (p. 54).

Fig. 1.—Portion of a colony; natural size.

Fig. 1*a*.—Portion of the same; magnified 15 diameters.

Figs. 2, 2*a*.—*Sertularia laxa*[1] [*exigua*] (p. 55).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 15 diameters.

Figs. 3, 3*a*.—*Sertularia polyzonias* (p. 55).

Fig. 3.—A colony; natural size.

Fig. 3*a*.—Portion of a colony; magnified 15 diameters.

[1] It has been found necessary to change the name since the Plate was printed off.

A.T.Hollick lith. West, Newman & Co. imp.

1, 1a. SERTULARIA IMPLEXA. 2, 2a. SERTULARIA EXIGUA.
3, 3a. SERTULARIA POLYZONIAS.

PLATE XXVII.

PLATE XXVII.

Figs. 1, 1*a*, 1*b*, 1*c*.—*Sertularia exserta* (p. 56).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Portion of a colony; magnified 25 diameters. The hydranths are here shown in their permanently exserted condition, and ectodermal bands are seen to extend from the body of the hydranth to the walls of the hydrotheca.

Fig. 1*b*.—Base of a tentacle showing the cushion with its battery of thread-cells; magnified 100 diameters.

Fig. 1*c*.—Thread-cells detached from the cushion; magnified 150 diameters.

Figs. 2, 2*a*.—*Sertularia abietina* (p. 62).

Fig. 2.—Portion of a colony; natural size.

Fig. 2*a*.—Portion of the same; magnified 15 diameters.

1, 1ª, 1b, 1c SERTULARIA EXSERTA. 2, 2ª SERTULARIA ABIETINA

PLATE XXVIII.

PLATE XXVIII.

Figs. 1, 1*a*.—*Sertularia echinocarpa* (p. 57).

Fig. 1.—Portion of a colony; natural size.

Fig. 1*a*.—Portion of same; magnified 10 diameters.

Figs. 2, 2*a*.—*Sertularia catena* (p. 58).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 10 diameters.

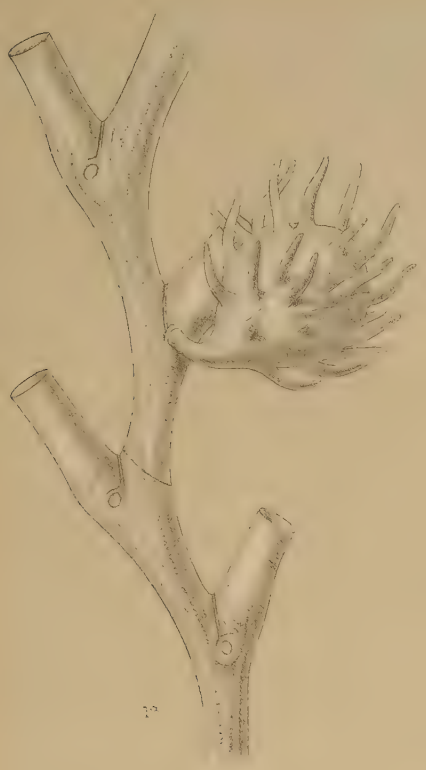
Figs. 3, 3*a*, 3*b*.—*Sertularia producta*[1] [*geniculata*] (p. 59).

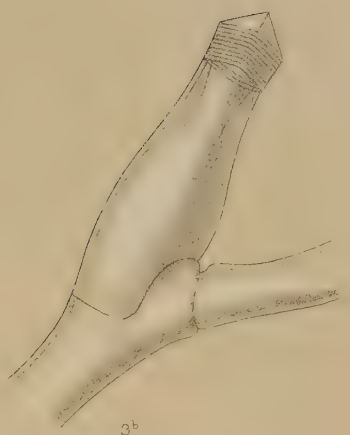
Fig. 3.—Portion of a colony; natural size.

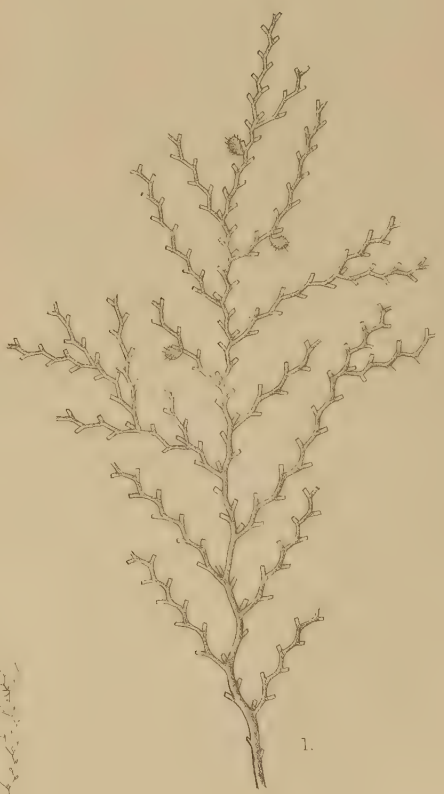
Fig. 3*a*.—Portion of same; magnified 15 diameters.

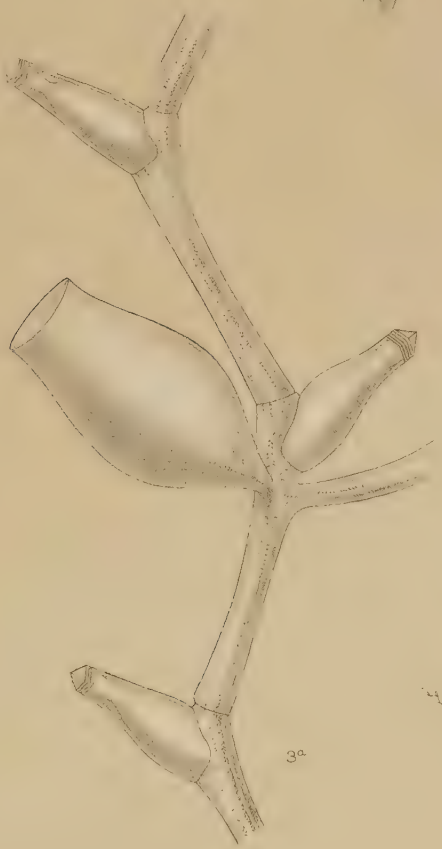
Fig. 3*b*.—A hydrotheca, further magnified; showing the striation of its summit, the operculum, and the internal projecting ridges.

[1] It has been found necessary to change the name since the Plate was printed off.









A. T. Hollick lith.

West, Newman & Co° imp.

1, 1ᴬ SERTULARIA ECHINOCARPA. 2, 2ᴬ SERTULARIA CATENA.
3, 3ᴬ, 3ᴮ SERTULARIA GENICULATA.

PLATE XXIX.

PLATE XXIX.

Figs. 1, 1*a*.—*Sertularia cylindritheca* (p. 59).

Fig. 1.—Portion of a colony; natural size.

Fig. 1*a*.—Portion of same; magnified 10 diameters.

Figs. 2, 2*a*.—*Sertularia integritheca* (p. 60).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 10 diameters.

Figs. 3, 3*a*.—*Sertularia articulata* (p. 61).

Fig. 3.—Portion of a colony; natural size.

Fig. 3*a*.—Portion of same; magnified 20 diameters.

1. 1ª SERTULARIA CYLINDRITHECA. 2. 2ª SERTULARIA INTEGRITHECA
3. 3ª SERTULARIA ARTICULATA.

PLATE XXX.

PLATE XXX.

Figs. 1, 1*a*.—*Sertularia operculata* (p. 61).

Fig. 1.—Portion of a colony; natural size.

Fig. 1*a*.—Portion of same; magnified 20 diameters.

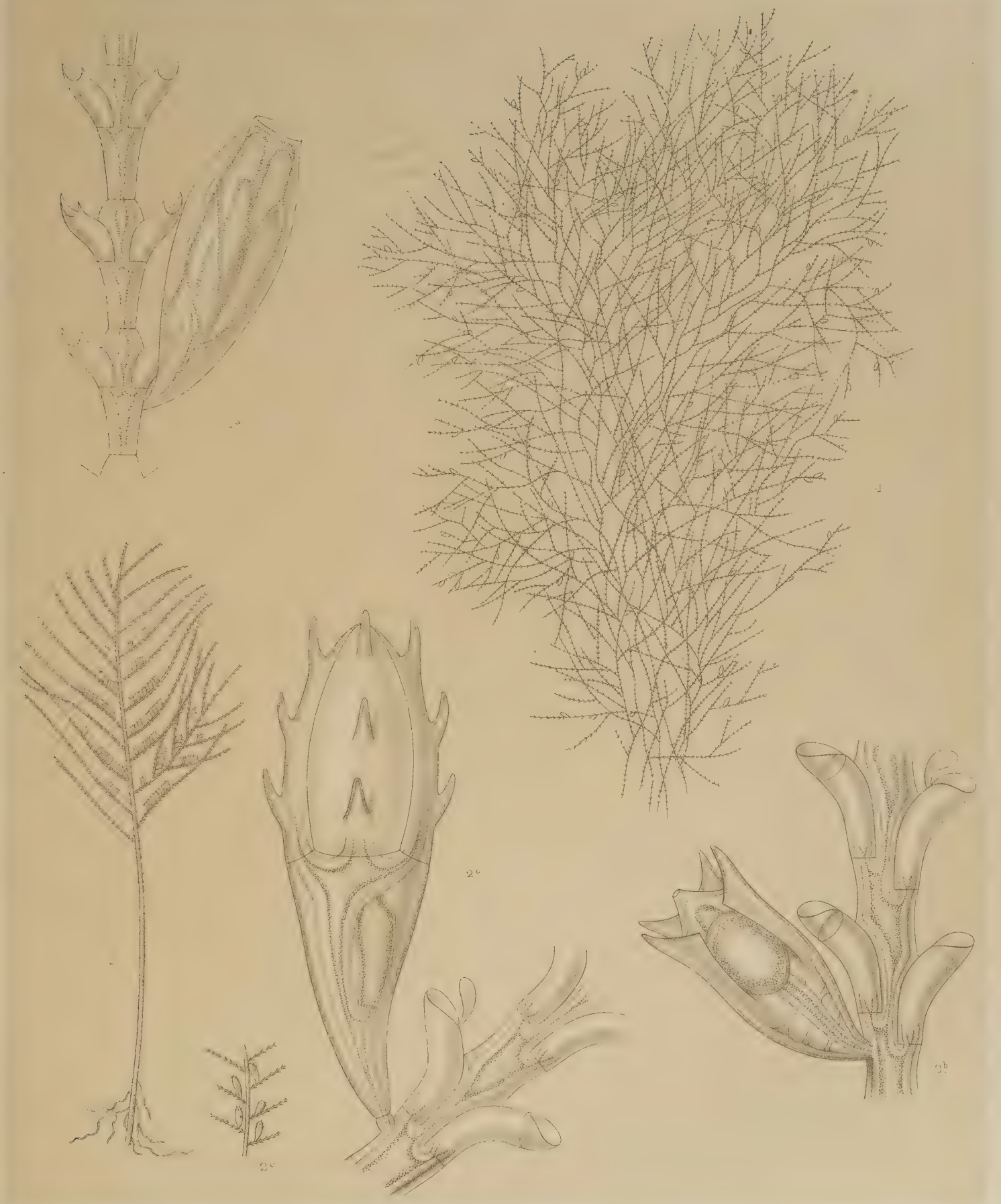
Figs. 2, 2*a*, 2*b*, 2*c*.—*Diphasia pinaster* (p. 63).

Fig. 2.—A male colony; natural size.

Fig. 2*a*.—Part of a female colony with its gonangium; magnified about 20 diameters.

Fig. 2*b*.—Part of a male colony with its gonangium; magnified about 20 diameters.

Fig. 2*c*.—Part of a female colony; natural size.



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1, 1a SERTULARIA OPERCULATA. 2, 2A 2B 2C DIPHASIA PINASTER.

PLATE XXXI.

PLATE XXXI.

Figs. 1, 1*a*, 1*b*, 1*c*, 1*d*.—*Thuiaria pharmacopola* (p. 66).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—A portion of main stem, near its distal end, with a pinna; magnified 15 diameters. One gonangium is present on the pinna and the points from which others have fallen are seen between some of the pairs of hydrothecæ; front view.

Fig. 1*b*.—Portion of a pinna with three gonangia; lateral view; magnified 15 diameters.

Fig. 1*c*.—Transverse section of the stem towards the base with the cœnosarc removed by maceration in caustic potash, showing its cavity consisting of numerous longitudinal chambers formed by the coalescence of the thick chitinous walls of the tubes which compose the fascicled stem; magnified about 10 diameters.

Fig. 1*d*.—Transverse section of the stem near the distal end, similarly treated, showing a single cavity enclosed within the thick chitinous walls of the stem, here become monosiphonic; magnified about 20 diameters.

Figs. 2, 2*a*.—*Thuiaria quadridens* (p. 66).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Portion of a colony; magnified 20 diameters.

A T Bolton lith

1, 1A 1B 1C 1D THUIARIA PHARMACOPOLA. 2 2A THUIARIA QUADRIDENS

PLATE XXXII.

PLATE XXXII.

Figs. 1, 1*a*, 1*b*, 1*c*.—*Thuiaria cupressina* (p. 67).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—A portion of a pinna; magnified 30 diameters.

Fig. 1*b*.—Part of the main stem with the origin of a pinna; magnified 15 diameters.

Fig. 1*c*.—Outline of part of a pinna near its origin, showing its mode of bifurcation; magnified 15 diameters.

Figs. 2, 2*a*.—*Thuiaria vincta* (p. 68).

Fig. 2.—Part of a colony; natural size.

Fig. 2*a*.—Part of a colony deprived of its cœnosarc by maceration in caustic potash, showing the chitinous bands by which the hydrothecæ of opposite sides are connected to one another; magnified 15 diameters.

A T Hollick lith

West, Newman & Co imp

1, 1ª 1ª 1ª THUIARIA CUPRESSINA. 2, 2ª THUIARIA VINCTA

PLATE XXXIII.

PLATE XXXIII.

Figs. 1, 1*a*.—*Thuiaria pectinata* (p. 69).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Part of a colony; magnified 15 diameters.

Figs. 2, 2*a*.—*Thuiaria hyalina* (p. 69).

Fig. 2.—Part of a colony; natural size.

Fig. 2*a*.—Part of a colony; magnified 15 diameters. It shows the permanently exserted condition of the hydranths, and the ectodermal bands by which the body of the hydranth is connected to the walls of the hydrotheca.

1. *Id.* THUIARIA PECTINATA.

2. 2*a* THUIARIA HYALINA

PLATE XXXIV.

PLATE XXXIV.

Figs. 1, 1*a*, 1*b*.—*Desmoscyphus pectinatus* (p. 71).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Part of a colony; magnified 15 diameters.

Fig. 1*b*.—Outline of part of a pinna, viewed in profile, showing the hydrothecæ all brought to one side of the internodes; magnified 15 diameters.

Figs. 2, 2*a*, 2*b*, 2*c*.—*Desmoscyphus gracilis* (p. 71).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Part of a colony; magnified 15 diameters. Towards the basal end of the stem the proximal part of a pinna (*a*) is seen with the spine-like termination from which the more distal part had become detached.

Fig. 2*b*.—A pair of connate hydrothecæ; magnified about 30 diameters. Front view.

Fig. 2*c*.—The same, dorsal view.

Figs. 3, 3*a*.—*Desmoscyphus obliquus* (p. 72).

Fig. 3.—A colony; natural size.

Fig. 3*a*.—Part of the same; magnified 15 diameters.

1. 1A 1B DESMOSCYPHUS PECTINATUS 2. 2A 2B 2C DESMOSCYPHUS GRACILIS
3. 3A DESMOSCYPHUS OBLIQUUS

PLATE XXXV.

PLATE XXXV.

Figs. 1, 1*a*.—*Hypopyxis labrosa* (p. 74).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—A portion of the same; magnified 15 diameters. The minute sarcothecæ are seen at the base of every hydrothecæ. In several of the hydrothecæ the expanded lip is still retained.

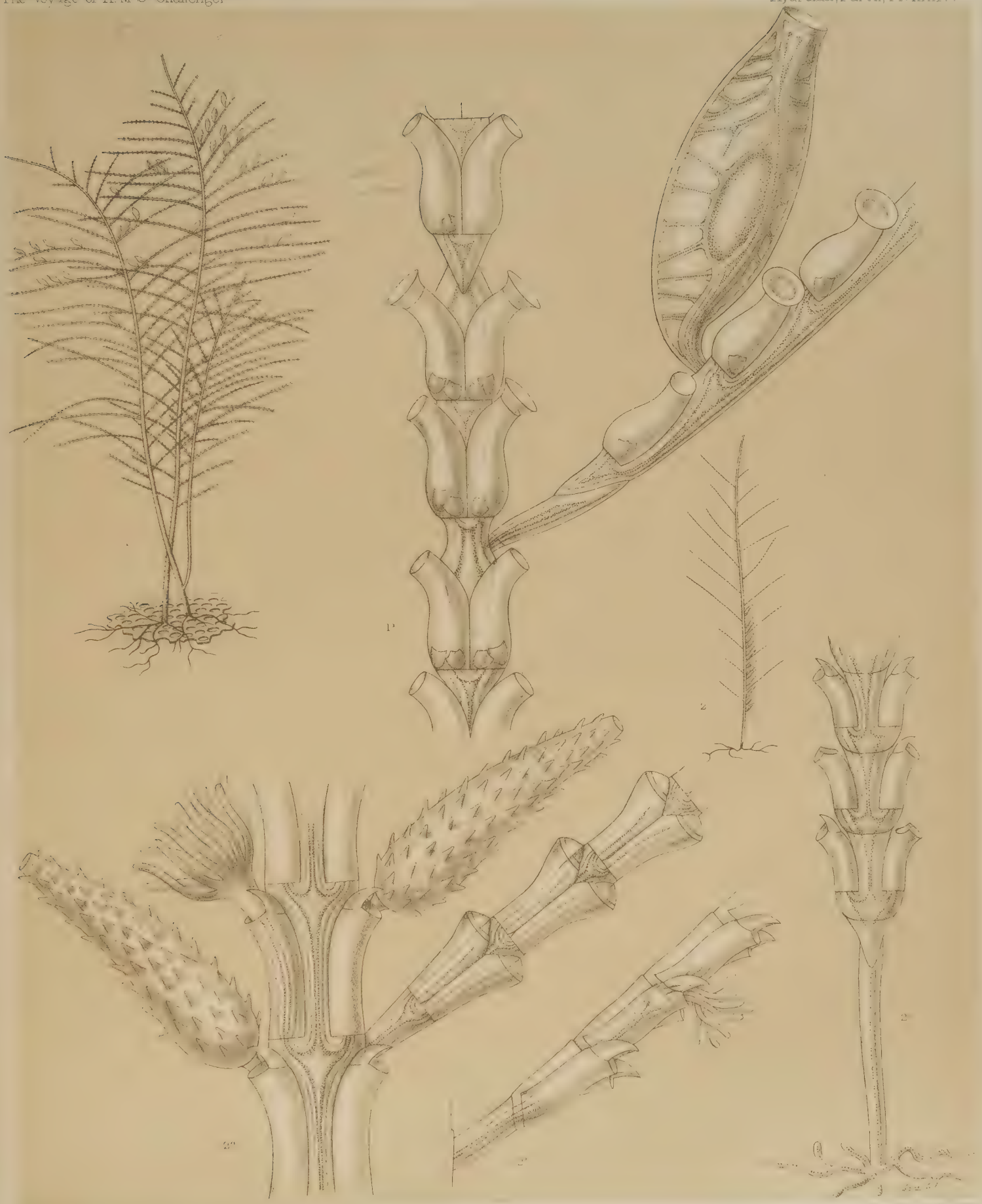
Figs. 2, 2*a*, 2*b*, 2*c*.—*Desmoscyphus acanthocarpus* (p. 73).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—A part of a colony; magnified 15 diameters. Front view.

Fig. 2*b*.—A part of the same; magnified 15 diameters. Lateral view.

Fig. 2*c*.—Hydrorhizal end of the main stem; magnified about 10 diameters.



A.T.Hollick lith.

1, 1A HYPOPYXIS LABROSA. 2, 2A 2B 2C DESMOSCYPHUS ACANTHOCARPUS.

PLATE XXXVI.

PLATE XXXVI.

Figs. 1, 1*a*.—*Staurotheca dichotoma* (p. 76).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Part of a colony; magnified 10 diameters. The extremity of a neighbouring branch is seen with its tendril-like continuation, which has become attached by its extremity to the hydrocaulus near the base of a hydrotheca.

Figs. 2, 2*a*.—*Dictyocladium dichotomum* (p. 77).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Part of a colony; magnified 15 diameters. The tendril-like continuation of one of the branches is seen to have attached itself by its extremity to the orifice of a hydrotheca on a neighbouring branch.

A.T. Hollick lith. West, Newman Cº imp.

1, 1ª STAUROTHECA DICHOTOMA. 2, 2ª DICTYOCLADIUM DICHOTOMUM

PLATE XXXVII.

PLATE XXXVII.

Figs. 1, 1*a*, 1*b*, 1*c*.—*Synthecium campylocarpum* (p. 78).

Fig. 1.—A colony; natural size.

Fig. 1*a*.—Part of a colony; magnified 15 diameters.

Fig. 1*b*.—A pair of hydrothecæ with a gonangium from what is probably a male colony of the same species; magnified 15 diameters.

Fig. 1*c*.—Basal portion of a pinna in which the gonangia are replaced by hydrotheca-bearing ramuli; magnified about 8 diameters.

Figs. 2, 2*a*.—*Synthecium alternans* (p. 80).

Fig. 2.—A colony; natural size.

Fig. 2*a*.—Part of a colony; magnified 15 diameters.

A. Rodrick lith

West, Newman & Co imp

1, 1ª 1ᵇ 1ᶜ SYNTHECIUM CAMPYLOCARPUM.
2, 2ª SYNTHECIUM ALTERNANS.

PLATE XXXVIII.

PLATE XXXVIII.

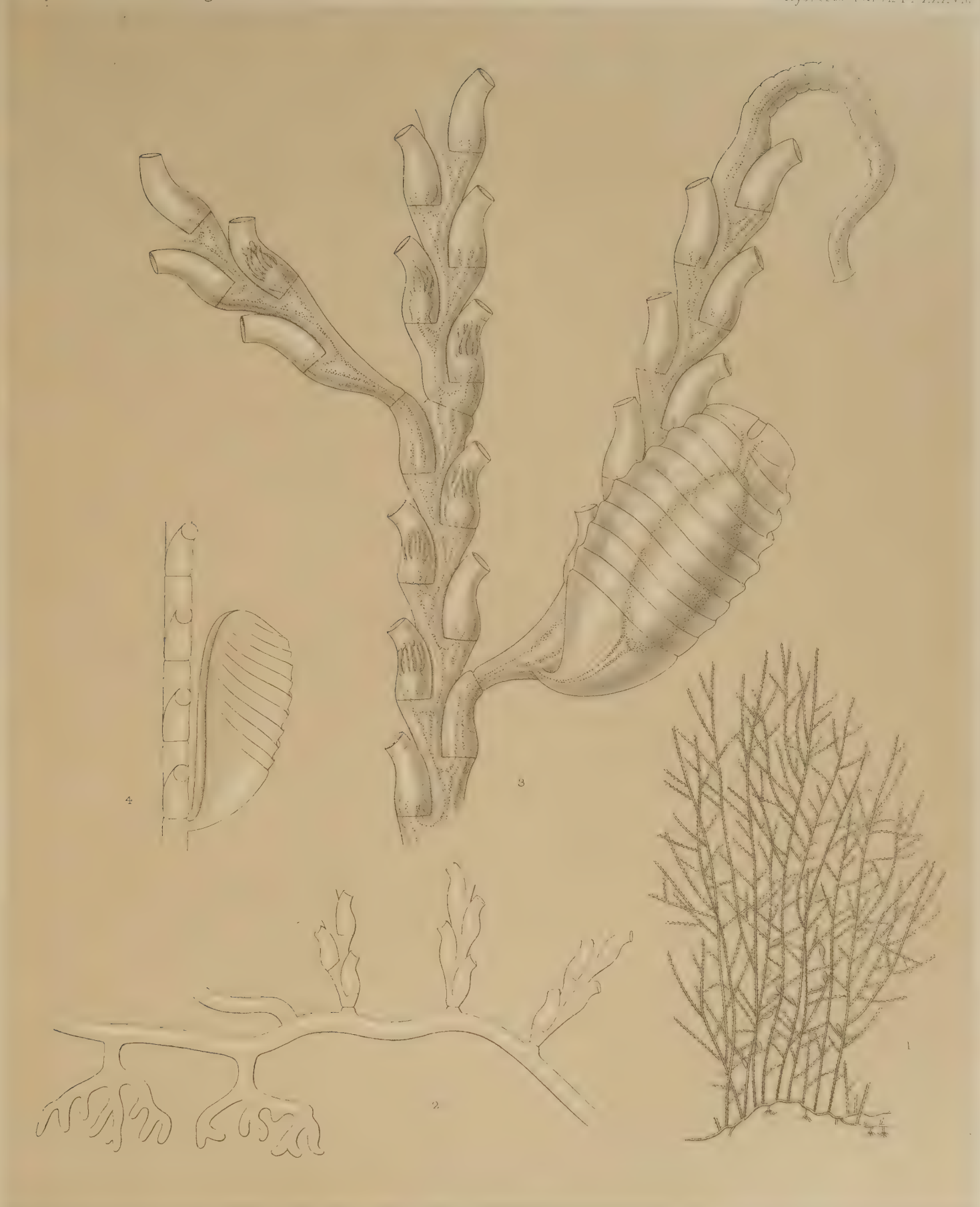
Figs. 1–4.—*Thecocladium flabellum* (p. 81).

Fig. 1.—A colony; natural size.

Fig. 2.—Outline of proximal part of a colony, showing the mode in which the stolon is rooted, with the origins of some of the stems; magnified about 8 diameters.

Fig. 3.—Portion of a colony, magnified 15 diameters; showing the origin of the branches, each from within the cavity of a hydrotheca. One of the branches is seen to terminate in a tendril-like continuation.

Fig. 4.—Outline of part of a branch, viewed laterally, showing the deep furrow in one side of the gonangium; magnified about 10 diameters.



A. T. Hollidaith

West, Newman & Co. imp.

THECOCLADIUM FLABELLUM.

PLATE XXXIX.

PLATE XXXIX.

Figs. 1–10.—*Idia pristis* (p. 85).

Fig. 1.—A colony; natural size.

Fig. 2.—Part of a pinna, superficial view from the front; magnified 15 diameters.

Fig. 3.—The same, posterior aspect, focussed at some distance from the surface, showing the polygonal areas into which the common cavity is divided by offsets of the perisarc; magnified 15 diameters.

Fig. 4.—The same; optical longitudinal section, deeper than that of fig. 3, showing the anterior chambers with their cœnosarcal lining; magnified 15 diameters.

Fig. 5.—Lateral view; longitudinal section showing the common posterior chamber and two of the anterior chambers with their corresponding hydrothecæ, in which the bases of the hydranths are still preserved; magnified 25 diameters.

Fig. 6.—One of the internodes of the main stem, showing the reticulated condition of its cœnosarcal lining; magnified about 15 diameters.

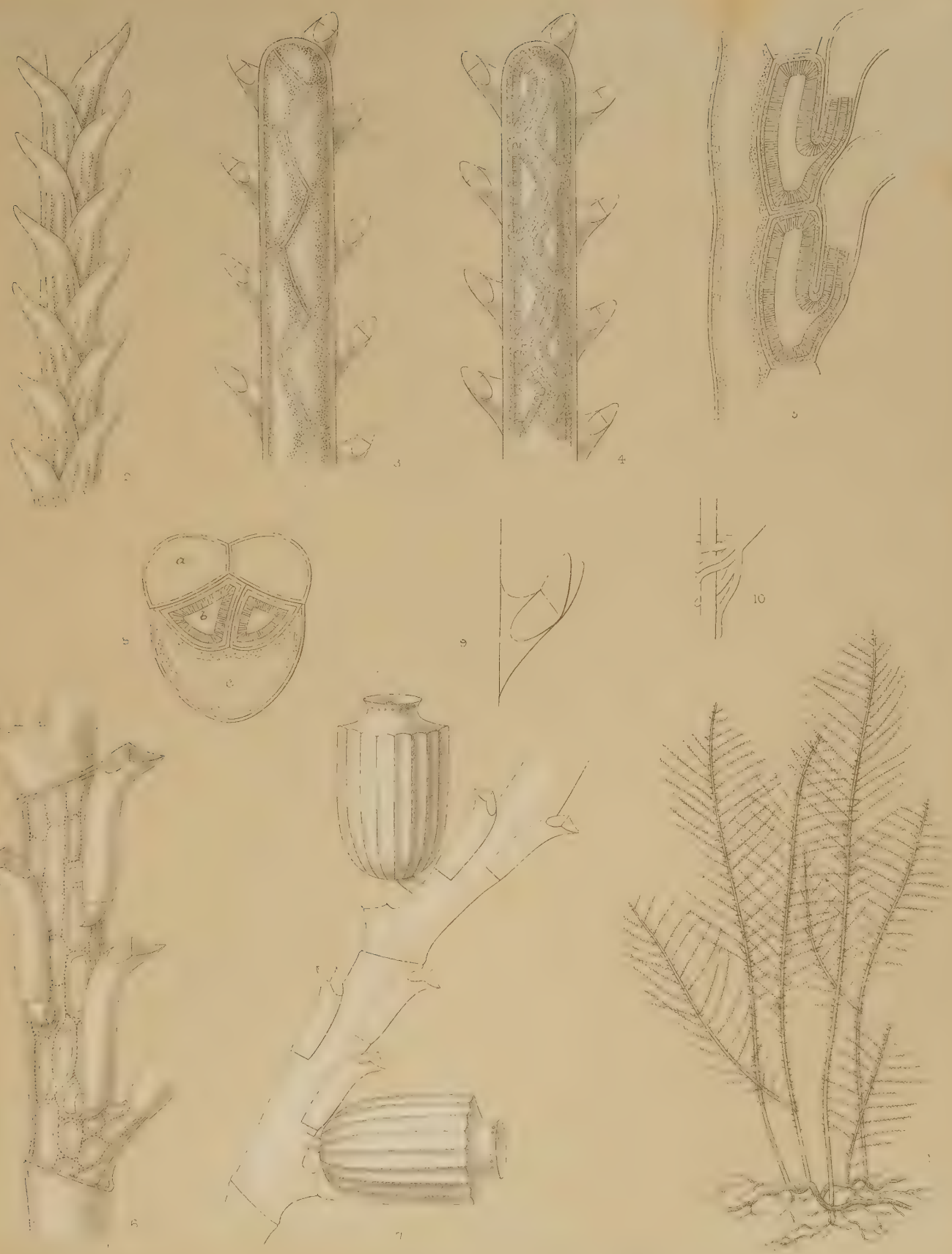
Fig. 7.—Portion of main stem with gonangia; magnified about 12 diameters.

Fig. 8.—Transverse section through a pinna; magnified 25 diameters.

a. Basal part of hydrotheca.
b. Anterior chamber.
c. Common posterior chamber.

Fig. 9.—Outline of distal extremity of hydrotheca, showing its valvular orifice.

Fig. 10.—Origin of a pseudo-branch; slightly magnified.



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IDIA PRISTIS.

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